

SAFETY.CAT.COM™

MAINTENANCE INTERVALS

Operation and Maintenance
Manual Excerpt

Operation and Maintenance Manual

966G and 972G Wheel Loaders

AAH1-Up (Machine)
3ZS1-Up (Machine)
7LS1-Up (Machine)
9RS1-Up (Machine)
1EW1-Up (Machine)
3PW1-Up (Machine)
3SW1-Up (Machine)
4WW1-Up (Machine)
6AW1-Up (Machine)
8XW1-Up (Machine)
9GW1-Up (Machine)
AAW1-Up (Machine)

i01811770

Maintenance Interval Schedule

SMCS Code: 7000

When Required

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Every 2000 Service Hours or 1 Year

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Every 5000 Service Hours or 3 Years

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Every 6000 Service Hours or 4 Years

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i01722752

Articulation Bearings - Lubricate

SMCS Code: 7057-086-BD; 7065-086-BD;
7066-086-BD

Wipe off the fittings before any lubricant is applied.



Illustration 166

g00885520

Apply lubricant through one fitting on the upper hitch.

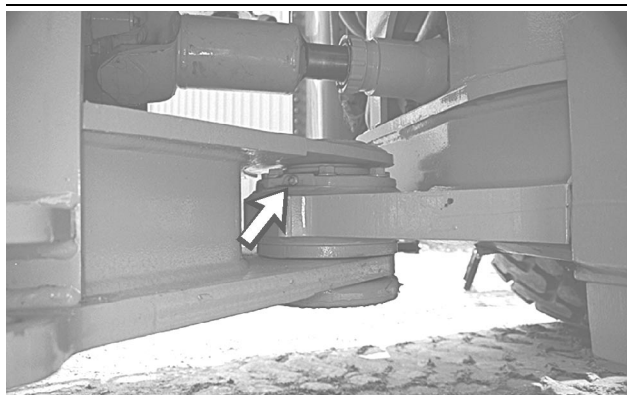


Illustration 167

g00885521

Apply lubricant through one fitting on the lower hitch.

i01713787

Axle Oscillation Bearings - Lubricate

SMCS Code: 3268-086-BD; 3278-086-BD



Illustration 168

g00881941

Open the rear access panel that is located on the left side of the machine in order to gain access to the remote grease fittings.

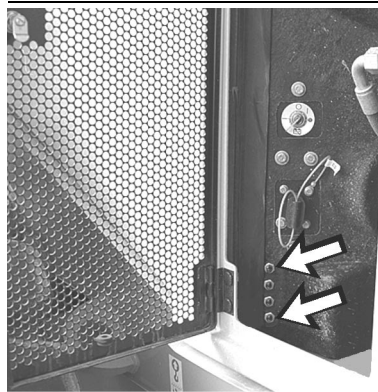


Illustration 169

g00881949

Wipe all fittings before lubricating.

The top remote grease fitting will lubricate the axle pivot bearing that is on the front of the rear axle. The bottom remote grease fitting will lubricate the axle pivot bearing that is on the rear of the rear axle.

Note: 5P-0960 Molybdenum Grease is preferred. 1P-0808 Multipurpose Grease may be used.

i01713831

Backup Alarm - Test (If Equipped)

SMCS Code: 7406-081

Turn the engine start switch to the ON in order to perform the test.

Apply the service brake. Place the transmission into reverse.

The backup alarm should start to sound immediately. The backup alarm will continue to sound until the transmission is placed into neutral or into forward.

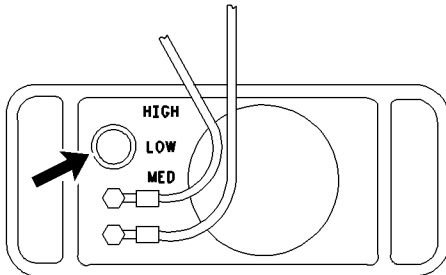


Illustration 170

g00881968

A three-position switch on the backup alarm regulates the volume of the alarm.

The backup alarm is set for the highest sound level when the machine is shipped from the factory. The setting should remain on HIGH unless the job site requires a lower sound level.

i01713837

Battery - Clean

SMCS Code: 1401-070

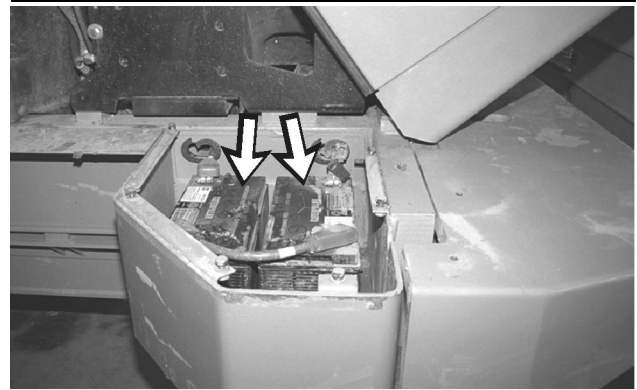


Illustration 171

g00881970

Open the battery compartment on the left rear side of the machine.

Clean the battery terminals and the surfaces of the batteries with a clean cloth. Coat the battery terminals with petroleum jelly. Make sure that the battery cables are installed securely.

i01772876

Battery - Recycle

SMCS Code: 1401-561

1. Always recycle a battery. Never discard a battery.
2. Always return used batteries to one of the following locations:
 - A battery supplier
 - An authorized battery collection facility
 - A recycling facility

i01713999

Battery Hold-Down - Tighten

SMCS Code: 7257-527



Illustration 172

g00881970

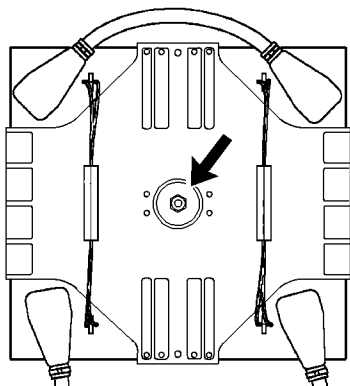


Illustration 173

g00882014

Open the battery compartment on the left rear side of the machine.

Over time, the vibration of an operating machine can cause the battery hold-down to loosen. To help to prevent loose batteries and the possibility of loose cable connections, tighten the locknut in the center of the hold-down to a torque of 14 ± 3 N·m (10 ± 2 lb ft).

i01770834

Battery or Battery Cable - Inspect/Replace

SMCS Code: 1401-040; 1401-510; 1402-040; 1402-510

1. Turn the engine start switch key OFF. Turn all of the switches OFF.
2. Turn the battery disconnect switch OFF. Remove the key.

3. Disconnect the negative battery cable from the disconnect switch.

Note: Do not allow the disconnected battery cable to contact the disconnect switch.

4. Disconnect the negative battery cable at the battery.
5. Disconnect the positive battery cable at the battery.
6. Inspect the battery terminals for corrosion. Inspect the battery cables for wear or damage.
7. Make any necessary repairs. If necessary, replace the battery cables or the battery.
8. Connect the positive battery cable at the battery.
9. Connect the negative battery cable at the battery.
10. Connect the battery cable at the battery disconnect switch.
11. Install the key and turn the battery disconnect switch ON.

i01488615

Belts - Inspect/Adjust/Replace

SMCS Code: 1357-025; 1357-040; 1357-510

Alternator Belt

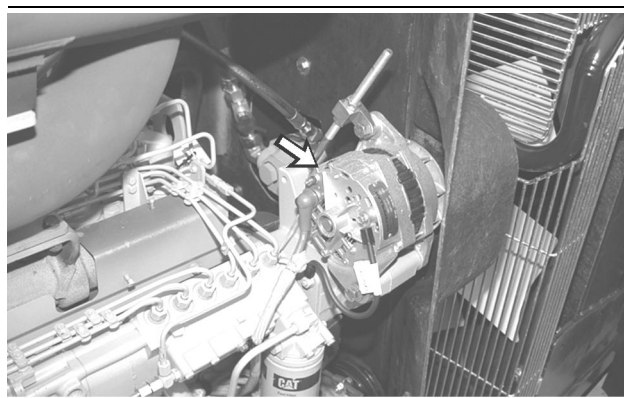


Illustration 174

g00285126

1. Stop the engine. Open the engine hood. The alternator is on the left side of the machine.
2. Inspect the condition of the alternator belt. If the belt is cracked or frayed, replace the belt.
3. Use a BT-33-72C Borroughs Gauge to check the tension of the alternator belt.

The tension of a used alternator belt with more than 30 minutes of operation at rated speed should be 400 ± 44 N (90 ± 10 lb). The tension of a new alternator belt with 30 minutes of operation or less at rated speed should be 534 ± 22 N (120 ± 5 lb).

Adjusting the Tension of the Alternator Belt

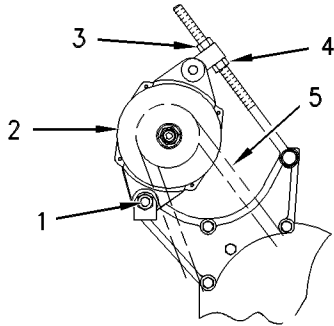


Illustration 175

g00284980

1. Loosen one mounting bolt (1) and adjusting nuts (3) and (4).
2. Turn adjusting nuts (3) and (4) counterclockwise in order to rotate alternator (2) outward until the correct belt tension is reached. Tighten the adjusting nuts.
3. Tighten mounting bolt (1).
4. Recheck the tension of belt (5). If the tension of the belt is incorrect, repeat the adjustment procedure.

Air Conditioner Belt

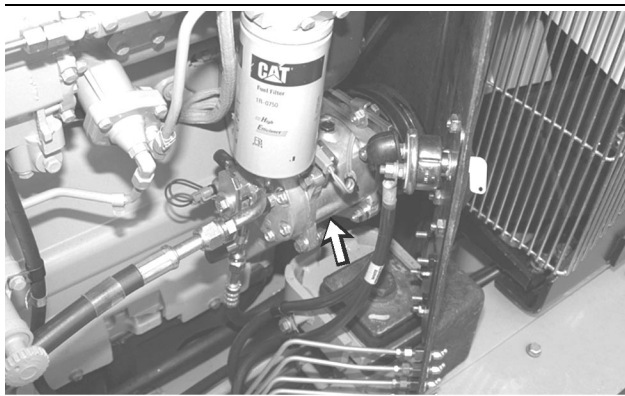


Illustration 176

g00285119

1. Stop the engine. Open the engine hood. The air conditioner compressor is on the left side of the machine.

2. Inspect the condition of the air conditioner belt. If the belt is cracked or frayed, replace the belt.
3. Use a BT-33-72C Borroughs Gauge to check the tension of the air conditioner belt.

The tension of a used air conditioner belt with more than 30 minutes of operation at rated speed should be 400 ± 44 N (90 ± 10 lb). The tension of a new air conditioner belt with 30 minutes of operation or less at rated speed should be 534 ± 22 N (120 ± 5 lb).

Adjusting the Tension of the Air Conditioner Belt

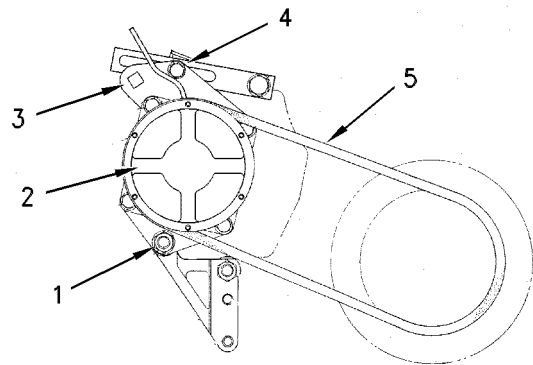


Illustration 177

g00284981

1. Loosen compressor bracket mounting bolt (1) and adjustment bolt (4).
2. Insert a ratchet with a square drive into the square hole in mounting bracket (3). Use the ratchet as a lever in order to rotate compressor (2) outward. Rotate the compressor until the correct belt tension is reached.
3. Tighten compressor bracket mounting bolt (1) and adjustment bolt (4).
4. Recheck the tension of belt (5). If the tension of the belt is incorrect, repeat the adjustment procedure.

i01714079

Brake Accumulator - Check

SMCS Code: 4263-535

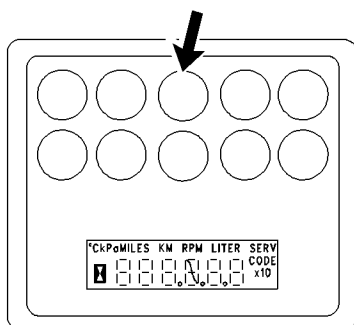


Illustration 178

g00882020

1. Turn the engine start switch to the ON position. The alert indicator for brake oil pressure should come on if the braking system is not at normal operating pressure.
2. Start the engine. Run the engine at half speed for two minutes in order to increase the accumulator pressure. The alert indicator for brake oil pressure should go off.
3. Stop the engine. Apply the service brake pedal and release the service brake pedal until the alert indicator for brake oil pressure comes on. This will decrease the accumulator pressure. A minimum of five applications of the service brake pedal are required.
4. If the alert indicator comes on after less than five applications of the brake, measure the accumulator precharge pressure. An authorized Caterpillar dealer can measure the nitrogen gas pressure in the accumulator. Use only dry nitrogen gas for recharging.

i01118779

Braking System - Test

SMCS Code: 4251-081; 4267-081

- Park the machine on a hard, dry, level surface.
- Check the area around the machine. Make sure that the machine is clear of personnel and clear of obstacles.
- Make sure that the steering frame lock is in the unlocked position.
- Fasten the seat belt before you test the brakes.

The following tests are used to determine whether the braking system is functional. These tests are not intended to measure the maximum brake holding effort. The required brake holding effort for sustaining a machine at a specific engine rpm varies from one machine to another machine. The variations include differences in the engine setting, the power train efficiency, the brake holding ability, etc.

Service Brake Holding Ability Test

WARNING

Personal injury can result if the machine moves while testing.

If the machine begins to move during test, reduce the engine speed immediately and engage the parking brake.

1. Start the engine. Raise the implement slightly. Apply the service brake. Release the parking brake.
2. Move the transmission control to SECOND SPEED REVERSE while the service brakes are applied. Make sure that the autoshift control is in the OFF position.
3. Gradually increase the engine speed to high idle. The machine should not move.
4. Reduce the engine speed to low idle. Move the transmission direction control to the NEUTRAL position. Engage the parking brake. Lower the implement to the ground. Stop the engine.

If the machine moved during the test, consult your Caterpillar dealer for a brake inspection. Make any necessary repairs before the machine is returned to operation.

Parking Brake Holding Ability Test

WARNING

Personal injury can result if the machine moves while testing.

If the machine begins to move, reduce the engine speed immediately and apply the service brake pedal.

This test is performed when the parking brake is engaged. If the machine begins to move, compare the engine rpm to the engine rpm of a prior test. This will indicate the amount of system deterioration.

1. Start the engine. Raise the implement slightly. Engage the parking brake.
2. Move the transmission control to THIRD SPEED REVERSE. Make sure that the autoshift control is in the OFF position.

The parking brake indicator light should come on.

3. Gradually increase the engine speed to high idle. The machine should not move.
4. Reduce the engine speed to low idle. Move the transmission direction control to the NEUTRAL position. Lower the implement to the ground. Stop the engine.

If the machine moved during the test, consult your Caterpillar dealer for a brake inspection. Make any necessary repairs before the machine is returned to operation.

Bucket Cutting Edges - Inspect/Replace

i01697186

SMCS Code: 6801-040; 6801-510

WARNING

Personal injury or death can result from bucket falling.

Block the bucket before changing bucket cutting edges.

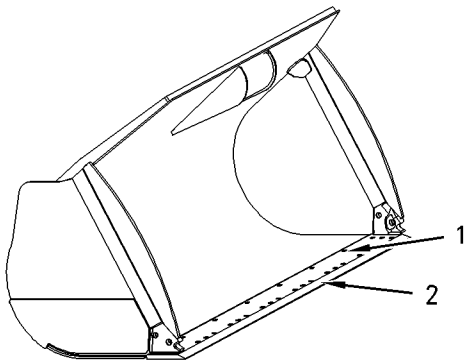


Illustration 179

g00764365

Check the cutting edges and the end bits for wear and for damage. Use the following procedure to service the cutting edges and the end bits, if necessary.

1. Raise the bucket and place blocking under the bucket.
2. Lower the bucket onto the blocking. Stop the engine.
3. Remove bolts (1), cutting edge (2) and the end bits.
4. Clean all contact surfaces.
5. If the opposite side of the cutting edge is not worn, use the opposite side of the cutting edge. The end bits are not reversible.

If both sides are worn, install a new cutting edge.

6. Install bolts (1). Tighten the bolts to the specified torque.

Reference: Refer to Operation and Maintenance Manual, "Torques for Ground Engaging Tool Bolts".

7. Start the engine. Raise the bucket and remove the blocking. Lower the bucket to the ground.
8. After a few hours of operation, check the bolts for proper torque.

Bucket Pivot Bearings - Lubricate

i01714107

SMCS Code: 6101-086-BD; 6107-086-BD

Wipe off the fittings before any lubricant is applied.

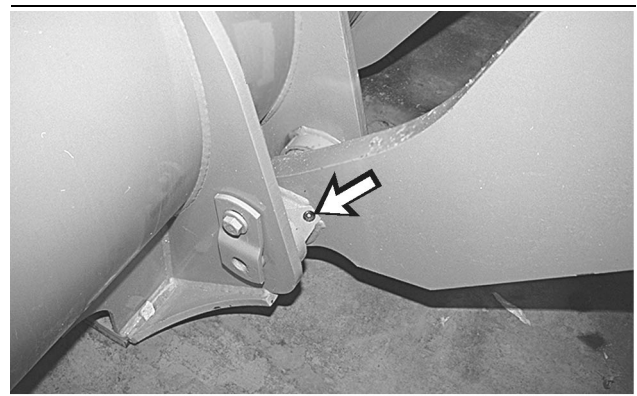


Illustration 180

g00882049

Apply lubricant through two fittings for the lower pivot bearings. There is one fitting on each side of the bucket.



Illustration 181

g00882050

Apply lubricant through one fitting on the upper pivot bearing.

There is a total of three fittings.

i01098716

Bucket Tips - Inspect/Replace

SMCS Code: 6805-040; 6805-510

WARNING

Personal injury or death can result from the bucket falling.

Block the bucket before changing bucket tips.

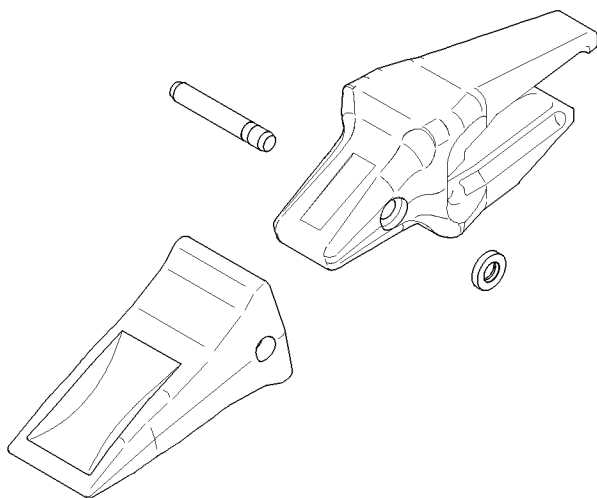


Illustration 182

g00486023

Inspect the bucket tips. If wear or damage is evident, use the following procedure to replace a bucket tip.

1. Drive the pin out of the bucket tip from the retainer side of the bucket tip. Remove the bucket tip and the retainer.
2. Clean the adapter, the pin, and the retainer. Install the retainer in the groove.
3. Install the bucket tip over the retainer.
4. Drive the pin through the bucket tip from the side that is opposite the retainer.

i01709216

Bucket Wear Plates - Inspect/Replace

SMCS Code: 6120-040; 6120-510

WARNING

Personal injury or death can result from the bucket falling.

Block the bucket before changing bucket wear plates.

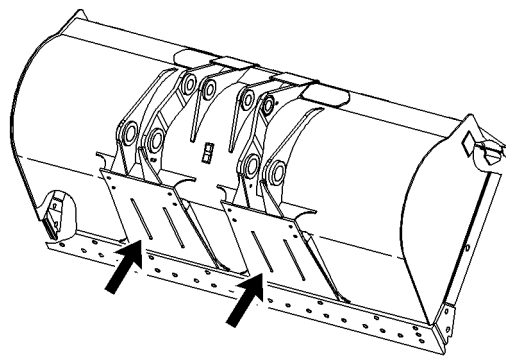


Illustration 183

g00879740

Inspect the wear plates. Replace the wear plates before damage to the bottom of the bucket occurs. Consult your Caterpillar dealer for replacement of wear plates.

i01014937

Cab Air Filter - Clean/Replace

SMCS Code: 7342-070; 7342-510

Note: Clean the cab air filters more often if the machine is being operated in dusty conditions.

i01119065

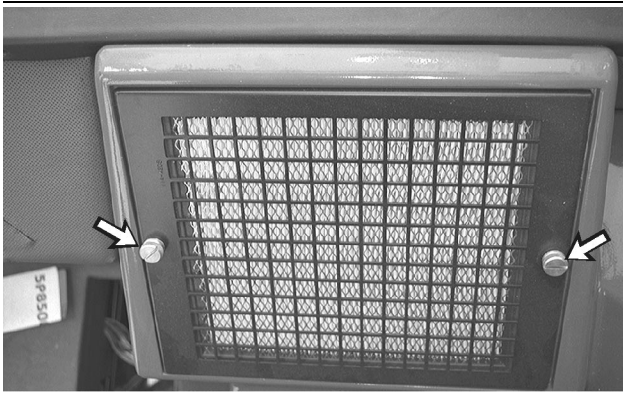


Illustration 184

g00100619

1. Remove the filter cover behind the seat. Remove the filter element.

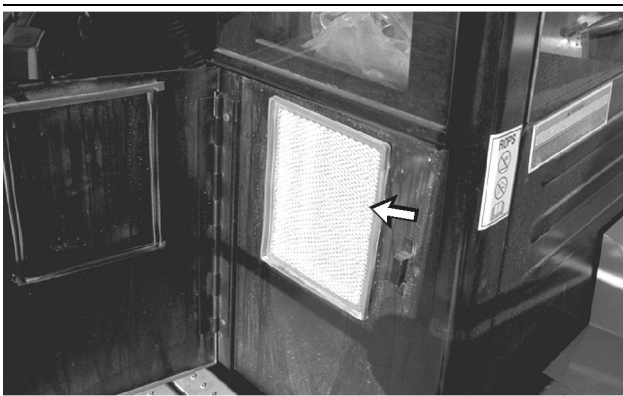


Illustration 185

g00550719

2. Open the access door on the left side of the cab. Remove the filter element.
3. Clean the filter elements with pressure air or wash the filter elements in warm water with a nonsudsing household detergent.
4. If water and detergent are used to clean the filter elements, rinse the filter elements in clean water and allow the filter elements to air dry thoroughly.

Note: If either filter element is damaged, install a new filter element.

5. Install the filter elements. Install the filter cover and close the access door.

Circuit Breakers - Reset

SMCS Code: 1420-529

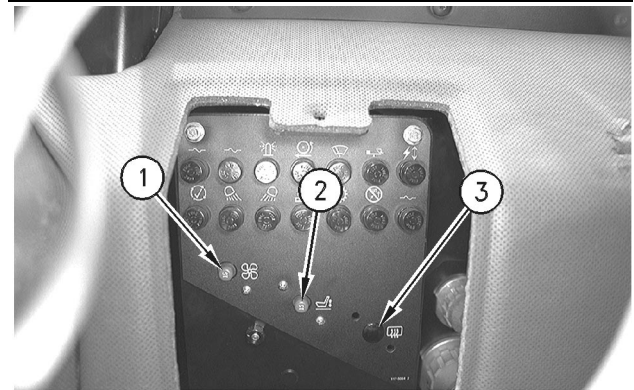


Illustration 186

g00100609



Circuit Breaker Reset – Depress the button in order to reset the circuit breakers. If the circuit is functioning properly, the button will remain depressed. If the button will not remain depressed, check the appropriate electrical circuit.

Circuit breakers and the fuses are located on the same panel at the back of the cab.



Fan Motor (1) – 15 amp



Seat Air Compressor (2) – 15 amp



Rear Defroster (3) (if equipped) – 15 amp



Illustration 187

g00282344

More circuit breakers are located in the engine compartment on the right side of the machine.

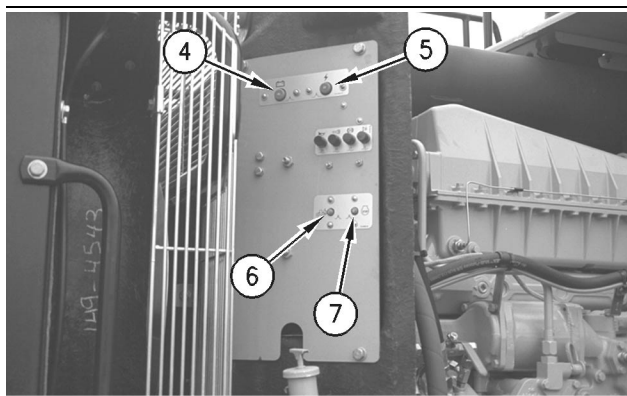


Illustration 188

g00287843



Alternator (4) – 80 amp



Main Circuit (5) – 80 amp



Tilt Hood Actuator (6) – 30 amp



Engine Shutdown (7) – 15 amp

i01103338

Cooling System Coolant (ELC) - Change

SMCS Code: 1350-044-NL

WARNING

Pressurized system: Hot coolant can cause serious burn. To open cap, stop engine, wait until radiator is cool. Then loosen cap slowly to relieve the pressure.

NOTICE

Mixing ELC with other products reduces the effectiveness of the coolant and shortens coolant life.

Use only Caterpillar products or commercial products that have passed the Caterpillar EC-1 specification for pre-mixed or concentrate coolants. Use only Caterpillar Extender with Caterpillar ELC.

Failure to follow these recommendations can result in shortened cooling system component life.

NOTICE

Care must be taken to ensure that fluids are contained during performance of inspection, maintenance, testing, adjusting and repair of the product. Be prepared to collect the fluid with suitable containers before opening any compartment or disassembling any component containing fluids.

Refer to Special Publication, NENG2500, "Caterpillar Tools and Shop Products Guide" for tools and supplies suitable to collect and contain fluids on Caterpillar products.

Dispose of all fluids according to local regulations and mandates.

Reference: For information about adding Extender to your cooling system, refer to Operation and Maintenance Manual, "Cooling System Coolant Extender (ELC) - Add" or consult your Caterpillar dealer.

If an Extended Life Coolant was previously used, flush the cooling system with clean water. No other cleaning agents are required. Use the following procedure to change the Extended Life Coolant.



Illustration 189

g00285598

The cooling system pressure cap is located under the engine hood at the rear of the machine.

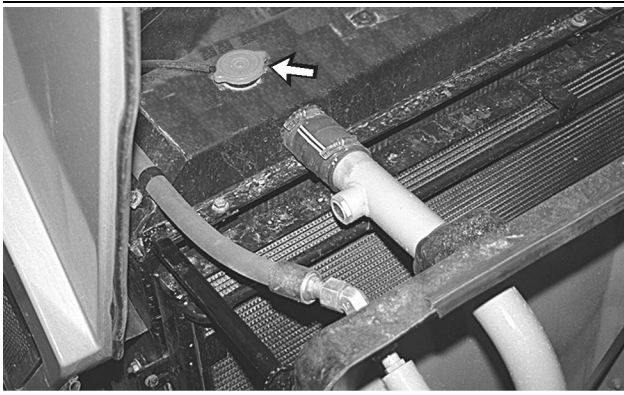


Illustration 190

g00285599

1. Slowly loosen the cooling system pressure cap in order to relieve any system pressure.



Illustration 191

g00285620

2. Open the access door on the left side of the machine in order to access the coolant drain valve. Open the drain valve at the bottom of the radiator. Allow the coolant to drain into a suitable container.
3. Flush the cooling system with clean water until the draining water is clean. Close the drain valve.
4. Replace the water temperature regulator.

Reference: Refer to Operation and Maintenance Manual, "Cooling System Water Temperature Regulator - Replace" for the correct procedure.

5. Add the Extended Life Coolant.

Reference: Refer to Operation and Maintenance Manual, "Refill Capacities" for the capacity of the cooling system.

6. Start the engine. Run the engine without the cooling system pressure cap until the water temperature regulator opens and the coolant level stabilizes.



Illustration 192

g00282345

7. Maintain the coolant level in the sight gauge on the upper radiator hose.
8. Install the cooling system pressure cap. Stop the engine.

i01152173

Cooling System Coolant Extender (ELC) - Add

SMCS Code: 1352-544-NL

WARNING

Pressurized system: Hot coolant can cause serious burn. To open cap, stop engine, wait until radiator is cool. Then loosen cap slowly to relieve the pressure.

NOTICE

Care must be taken to ensure that fluids are contained during performance of inspection, maintenance, testing, adjusting and repair of the product. Be prepared to collect the fluid with suitable containers before opening any compartment or disassembling any component containing fluids.

Refer to Special Publication, NENG2500, "Caterpillar Tools and Shop Products Guide" for tools and supplies suitable to collect and contain fluids on Caterpillar products.

Dispose of all fluids according to local regulations and mandates.

NOTICE

Mixing ELC with other products reduces the effectiveness of the coolant and shortens coolant life.

Use only Caterpillar products or commercial products that have passed the Caterpillar EC-1 specification for pre-mixed or concentrate coolants. Use only Caterpillar Extender with Caterpillar ELC.

Failure to follow these recommendations can result in shortened cooling system component life.

When a Caterpillar Extended Life Coolant (ELC) is used, an Extender must be added to the cooling system.

Use a **8T-5296** Coolant Test Kit to check the concentration of the coolant.

Reference: For additional information about the addition of Extender, refer to Operation and Maintenance Manual, SEBU6250, "Caterpillar Machine Fluids Recommendations" or consult your Caterpillar dealer.



Illustration 193

g00285598

The cooling system pressure cap is located under the engine hood at the rear of the machine. Tilt the hood in order to access the cooling system pressure cap.

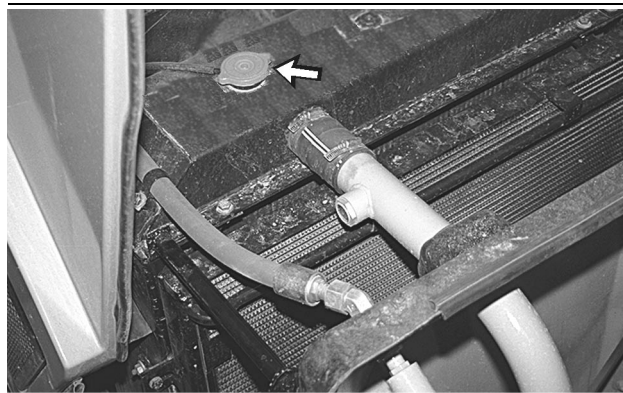


Illustration 194

g00285599

1. Slowly loosen the cooling system pressure cap in order to relieve any system pressure. Remove the cooling system pressure cap.



Illustration 195

g00285620

2. If necessary, drain enough coolant from the radiator in order to allow the addition of the Extender to the cooling system. The cooling system drain valve is located on the lower left side of the radiator.

3. Add the Extender to the cooling system.

Reference: Refer to Operation and Maintenance Manual, "Refill Capacities" for the correct amount.

4. Check the coolant level.

Reference: Refer to Operation and Maintenance Manual, "Cooling System Level - Check" for the correct procedure.

5. Install the cooling system pressure cap. Close the engine hood.

i01128466

Cooling System Level - Check

SMCS Code: 1350-535-FLV

WARNING

Pressurized system: Hot coolant can cause serious burn. To open cap, stop engine, wait until radiator is cool. Then loosen cap slowly to relieve the pressure.



Illustration 196

g00282344



Illustration 197

g00282345

Open the access door on the right side of the machine. The coolant level sight gauge is located on the top radiator hose.

Maintain the coolant level within the sight gauge. Add coolant, if necessary.

Note: If it is necessary to add coolant daily, inspect the cooling system for leaks.

i01119250

Cooling System Water Temperature Regulator - Replace

SMCS Code: 1355-510; 1393-010

WARNING

Pressurized system: Hot coolant can cause serious burn. To open cap, stop engine, wait until radiator is cool. Then loosen cap slowly to relieve the pressure.

NOTICE

Failure to replace the engine's thermostat on a regularly scheduled basis could cause severe engine damage.

NOTICE

Caterpillar engines incorporate a shunt design cooling system and require operating the engine with a thermostat installed.

If the thermostat is installed wrong, it will cause the engine to overheat. Inspect gaskets before assembly and replace if worn or damaged.



Illustration 198

g00282450

Water Temperature Regulator Housing

Replace the water temperature regulator in order to reduce the chance of problems with the cooling system.

Replace the water temperature regulator and the seals while the cooling system is completely drained or while the coolant is drained to a level that is below the water temperature regulator housing.

Note: If you are only replacing the water temperature regulator, drain the coolant to a level that is below the water temperature regulator housing.

Reference: Refer to Disassembly and Assembly, RENR2100, "3306 Engines for Caterpillar Built Machines" for the correct procedure for replacing the water temperature regulator.

i01710042

Differential and Final Drive Oil - Change

SMCS Code: 3278-044; 4011-044

NOTICE

Care must be taken to ensure that fluids are contained during performance of inspection, maintenance, testing, adjusting and repair of the product. Be prepared to collect the fluid with suitable containers before opening any compartment or disassembling any component containing fluids.

Refer to Special Publication, NENG2500, "Caterpillar Tools and Shop Products Guide" for tools and supplies suitable to collect and contain fluids on Caterpillar products.

Dispose of all fluids according to local regulations and mandates.

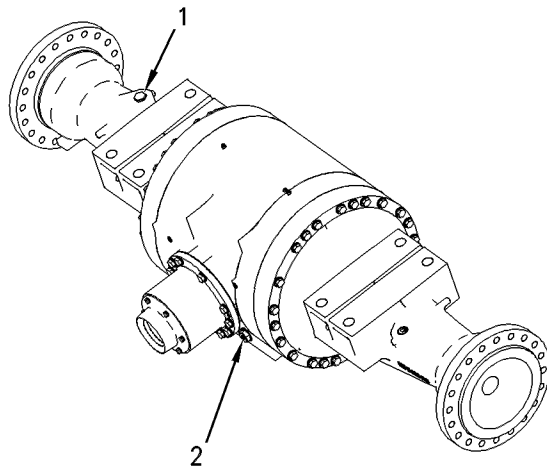


Illustration 199
Front Axle

g00287529

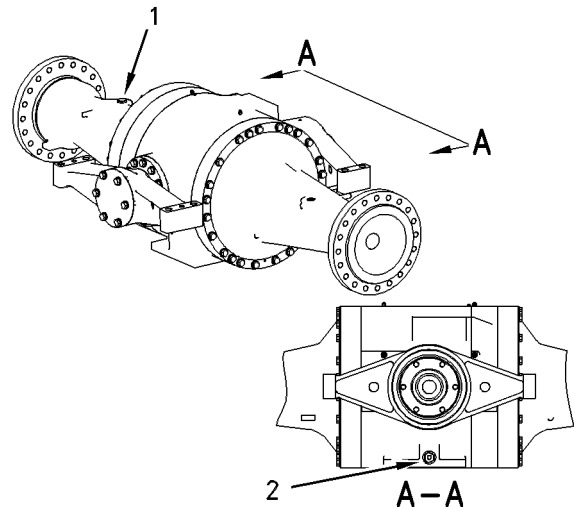


Illustration 200
Rear Axle

g00287531

Note: The axle housings are equipped with ecology drain valves.

1. Remove drain plugs (2). Attach a hose to a 126-7914 Oil Drain Coupling. Install the threaded end of the coupling into the drain valve. Allow the oil to drain into a suitable container.
2. Clean the drain plugs and install the drain plugs.
3. Wipe off dipstick/fill plugs (1) and the surfaces around dipstick/fill plugs (1).
4. Remove the dipstick/fill plugs. Fill each axle with 0.5 L (0.53 qt) of 1U-9891 Hydraulic Oil Additive. Fill the axles with oil.
5. Clean the dipstick/fill plugs and install the dipstick/fill plugs.
6. Run the machine on level ground for a few minutes in order to equalize the oil level in the axle. Check the oil level in the axle.

Reference: Refer to Operation and Maintenance Manual, "Lubricant Viscosities and Refill Capacities" for the type of lubricant and for the refill capacity.

Reference: Refer to Operation and Maintenance Manual, "Differential and Final Drive Oil Level - Check" for the correct procedure.

i01102280

Differential and Final Drive Oil Level - Check

SMCS Code: 3278-535-FLV; 4011-535-FLV

Note: Before you measure the oil level, operate the machine for a few minutes in order to equalize the oil level.

1. Park the machine on level ground. Lower the bucket and apply slight downward pressure. Engage the parking brake. Stop the engine.

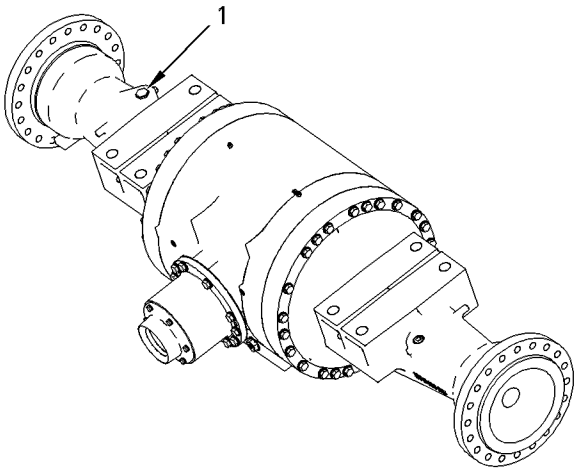


Illustration 201
Front Axle

g00285312

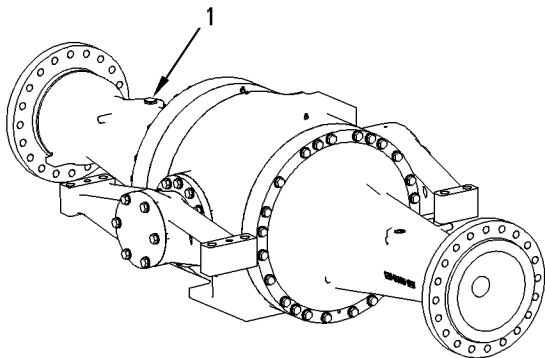


Illustration 202
Rear Axle

g00287527

2. Remove dipstick/fill plug (1) on the left side of the axle. Wipe off the level gauge with a clean cloth and reinsert the plug. This will ensure a more accurate measurement of the oil level.

Note: Make sure that the plug is installed completely before you check the oil level. If the plug is not installed completely, an incorrect oil level reading can occur.

3. Remove dipstick/fill plug (1) again and check the oil level. Maintain the oil level between the ADD mark and the FULL mark. Add oil, if necessary.

Reference: Refer to Operation and Maintenance Manual, "Lubricant Viscosities and Refill Capacities" for the type of lubricant and for the refill capacity.

4. Clean the plug and install the plug.

i01714466

Drive Shaft Spline (Center) - Lubricate

SMCS Code: 3253-086-SN

Wipe all of the fittings before you apply grease to the fittings.

NOTICE

To prevent damage to the seal, articulate the machine full right or left, before lubricating the splines.

1. Start the engine. Raise the bucket. Release the parking brake. Articulate the machine to the right or to the left in order to gain better access to the splined shaft.
2. Lower the bucket to the ground. Engage the parking brake. Stop the engine.



Illustration 203
Location of the center drive shaft

g00882399

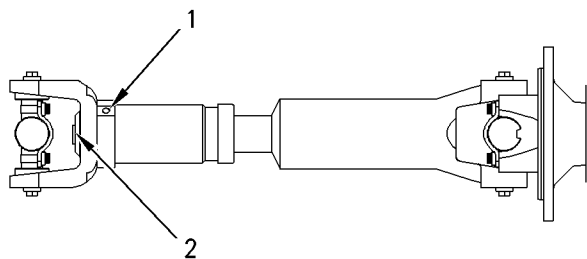


Illustration 204

g00882402

3. Apply grease to the fitting (1). Apply grease until the relief (2) overruns.

Note: 5P-0960 Molybdenum Grease is preferred. 1P-0808 Multipurpose Grease may be used.

4. Start the engine. Raise the bucket. Release the parking brake. Reposition the machine in a straight direction without articulation.
5. Lower the bucket to the ground. Apply a slight down pressure. Engage the parking brake. Stop the engine.

i01714637

Drive Shaft Universal Joints - Lubricate

SMCS Code: 3251-086

Wipe off all fittings before any lubricant is applied.

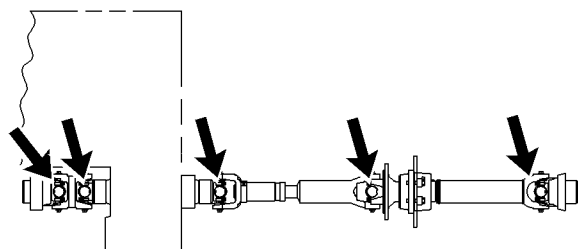


Illustration 205

g00882522

Apply lubricant through two fittings on each universal joints. There is a total of ten fittings.

Note: Use only 1P-0808 Multipurpose Grease. Do NOT use Molybdenum Disulfide Grease.

i01605387

Engine Air Filter Primary Element - Clean/Replace

SMCS Code: 1054-070-PY; 1054-510-PY

1. The rear hood should be opened in order to access the air filter. The air filter is located on the right side of the machine.

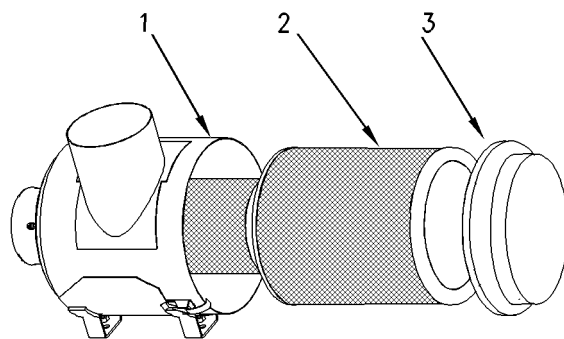


Illustration 206

g00806893

2. Remove the cover on air filter housings (3).
3. Remove primary element (2) from the air filter housing.
4. Clean the inside of air filter housing (1).
5. Inspect the primary element. If the pleats, the gaskets, or the seals are damaged, discard the element. Replace a damaged primary element with a clean primary element.

Cleaning Primary Air Filter Elements

NOTICE

Caterpillar recommends certified air filter cleaning services available at participating Caterpillar dealers. The Caterpillar cleaning process uses proven procedures to assure consistent quality and sufficient filter life.

Observe the following guidelines if you attempt to clean the filter element:

Do not tap or strike the filter element in order to remove dust.

Do not wash the filter element.

Use low pressure compressed air in order to remove the dust from the filter element. Air pressure must not exceed 207 kPa (30 psi). Direct the air flow up the pleats and down the pleats from the inside of the filter element. Take extreme care in order to avoid damage to the pleats.

Do not use air filters with damaged pleats, gaskets, or seals. Dirt entering the engine will cause damage to engine components.

The primary air filter element can be used up to six times if the element is properly cleaned and inspected. When the primary air filter element is cleaned, check for rips or tears in the filter material. The primary air filter element should be replaced at least one time per year. This replacement should be performed regardless of the number of cleanings.

NOTICE

Do not clean the air filter elements by bumping or tapping. This could damage the seals. Do not use elements with damaged pleats, gaskets, or seals. Damaged elements will allow dirt to pass through. Engine damage could result.

Visually inspect the primary air filter elements before cleaning. Inspect the air filter elements for damage to the seal, the gaskets, and the outer cover. Discard any damaged air filter elements.

There are two common methods that are used to clean primary air filter elements:

- Pressurized air
- Vacuum cleaning

Pressurized Air

Pressurized air can be used to clean primary air filter elements that have not been cleaned more than two times. Pressurized air will not remove deposits of carbon and oil. Use filtered, dry air with a maximum pressure of 207 kPa (30 psi).

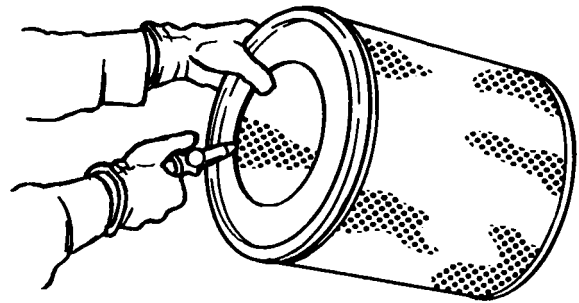


Illustration 207

g00281692

Note: When the primary air filter elements are cleaned, always begin with the clean side (inside) in order to force dirt particles toward the dirty side (outside).

Aim the hose so that the air flows inside the element along the length of the filter in order to help prevent damage to the paper pleats. Do not aim the stream of air directly at the primary air filter element. Dirt could be forced further into the pleats.

Vacuum Cleaning

Vacuum cleaning is another method for cleaning primary air filter elements which require daily cleaning because of a dry, dusty environment. Cleaning with pressurized air is recommended prior to vacuum cleaning. Vacuum cleaning will not remove deposits of carbon and oil.

Inspecting the Primary Air Filter Elements

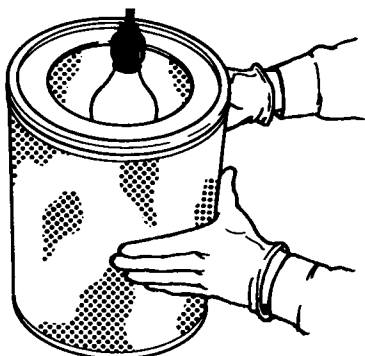


Illustration 208

g00281693

Inspect the clean, dry primary air filter element. Use a 60 watt blue light in a dark room or in a similar facility. Place the blue light in the primary air filter element. Rotate the primary air filter element. Inspect the primary air filter element for tears and/or holes. Inspect the primary air filter element for light that may show through the filter material. If it is necessary in order to confirm the result, compare the primary air filter element to a new primary air filter element that has the same part number.

Do not use a primary air filter element that has any tears and/or holes in the filter material. Do not use a primary air filter element with damaged pleats, gaskets or seals. Discard damaged primary air filter elements.

Storing Primary Air Filter Elements

If a primary air filter element that passes inspection will not be used, the primary air filter element can be stored for future use.

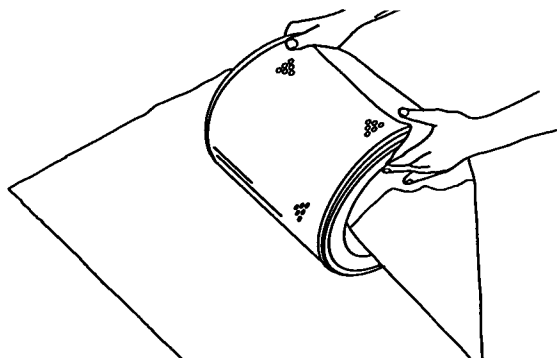


Illustration 209

g00281694

Do not use paint, a waterproof cover, or plastic as a protective covering for storage. An airflow restriction may result. To protect against dirt and damage, wrap the primary air filter elements in Volatile Corrosion Inhibited (VCI) paper.

Place the primary air filter element into a box for storage. For identification, mark the outside of the box and mark the primary air filter element. Include the following information:

- Date of cleaning
- Number of cleanings

Store the box in a dry location.

i01693619

Engine Air Filter Secondary Element - Replace

SMCS Code: 1054-510-SE

NOTICE

Service the air filter only with the engine stopped. Engine damage could result.

NOTICE

Always replace the secondary element. Do not attempt to reuse it by cleaning. Engine damage could result.

Note: Replace the secondary element when you service the primary element for the third time. If a clean primary element has been installed and a warning for the air filter still occurs, replace the secondary element. Also if the exhaust smoke remains black and a clean primary element has been installed, replace the secondary element.

1. Remove the primary element.

Reference: Refer to Operation and Maintenance Manual, "Engine Air Filter Primary Element - Clean/Replace" for the correct procedure.

i01102369

Engine Air Filter Service Indicator - Inspect

SMCS Code: 7452-040

NOTICE

Service the air cleaner only with the engine stopped. Engine damage could result.

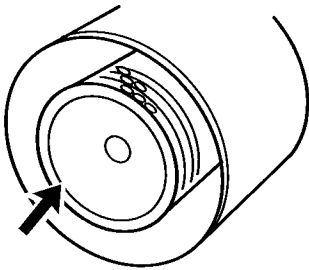


Illustration 210

g00864077

2. Remove the secondary element.

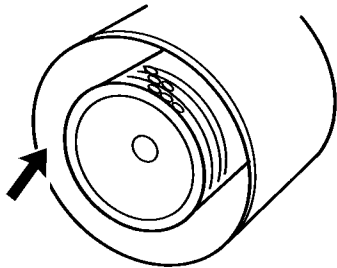


Illustration 211

g00864079

3. Cover the air inlet opening. Clean the inside of the air cleaner housing.
4. Inspect the gasket between the air inlet pipe and the air cleaner housing. Replace the gasket if the gasket is damaged.
5. Uncover the air inlet opening. Install a new secondary element.
6. Install a clean primary element and the cover for the air cleaner housing.
7. Close the access door.
8. Repeat the procedure for the other air cleaner.



Illustration 212

g00319443

Open the access door on the right side of the machine in order to access the service indicator.

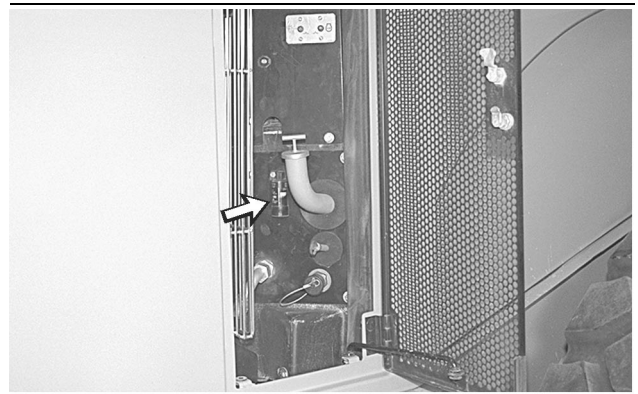


Illustration 213

g00288177

Service the air cleaner when the yellow piston in the service indicator is in the red zone. The service indicator can be checked when the engine is running or stopped.

i01331106

Engine Air Filter Service Indicator - Inspect/Replace

SMCS Code: 7452-040; 7452-510



Illustration 214

g00290893



Illustration 215

g00593006

To check the condition of the service indicator, try resetting the service indicator. This should require less than three pushes of the reset button.

Next, check the movement of the yellow piston in the service indicator. Start the engine and accelerate the engine to high idle for a few seconds. After the governor control pedal is released, the yellow piston should remain at the highest position that was achieved during acceleration.

If either of these conditions are not met, replace the service indicator.

i00594761

Engine Air Precleaner - Clean

SMCS Code: 1055-070



Illustration 216

g00282725

NOTICE

Service the air cleaner only with the engine stopped. Engine damage could result.

1. Remove the precleaner.
2. Inspect the air inlet screen for dirt and for trash. Remove the screen. Clean the screen if the screen is dirty.
3. Inspect the precleaner tube openings. Remove dirt and debris.
4. Clean the precleaner with compressed air or wash the precleaner in warm water. Dry all the parts.
5. Install the precleaner screen.

i00598143

Engine Crankcase Breather - Clean

SMCS Code: 1317-070



Illustration 217

g00282895

Open the hood on the rear of machine in order to access the engine compartment.

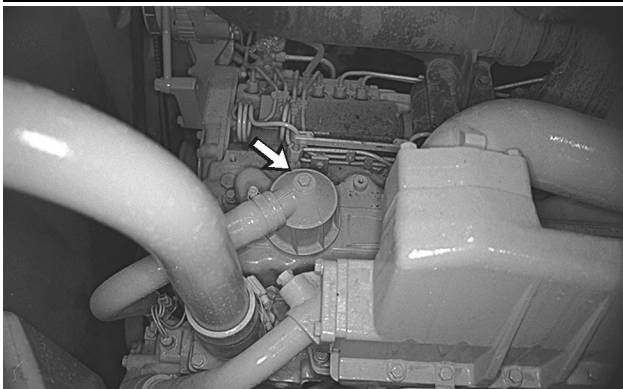


Illustration 218

g00283064

1. Loosen the breather outlet hose clamp and remove the hose from the breather.

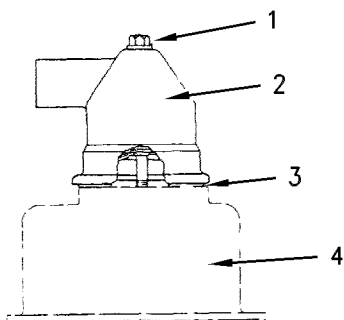


Illustration 219

g00283062

Bolt (1). Breather assembly (2). O-Ring seal (3). Engine valve cover (4).

2. Remove the bolt that holds the breather onto the valve cover. Remove the breather.
3. Check the condition of the cover seal. Replace the seal if the seal is damaged.
4. Wash the cover and the element in a clean nonflammable solvent.
5. Shake the element or use pressure air in order to dry the element.
6. Inspect the hose for damage. Replace the hose if it is necessary.
7. Install the breather assembly. Install the hose and install the hose clamp.
8. Close the access door.

i01151893

Engine Oil (High Speed) and Oil Filter - Change (If Equipped)

SMCS Code: 1318-510-HZ

Your machine may be equipped with a high speed arrangement for changing the engine oil. The high speed arrangement allows the engine oil to be changed faster than the conventional method.



Illustration 220

g00319443

1. Open the access door on the right side of the machine.



Illustration 221

g00431382

2. Remove the cap that protects the male coupler. Connect an oil pump to the fitting.
3. Turn on the oil pump and withdraw the engine oil from the engine crankcase.



Illustration 222

g00282895

4. Close the access door. Open the engine hood in order to access the engine oil filter.

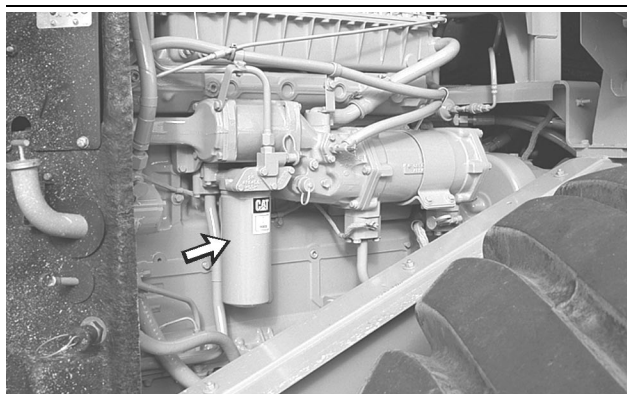


Illustration 223

g00283449

5. Use a strap type wrench to remove the used oil filter element.
6. Clean the filter mounting base with a clean cloth.

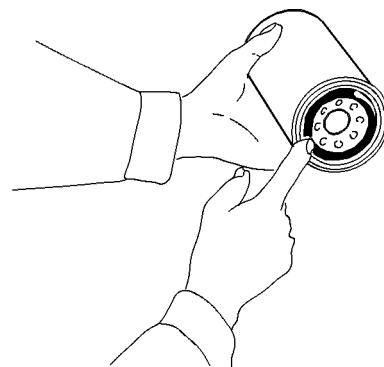


Illustration 224

g00101318

7. Apply a thin film of clean engine oil to the sealing surface of the new filter element.
8. Install the new filter element hand tight. When the gasket contacts the filter base, tighten the filter by an additional 3/4 turn.



Illustration 225

g00431382

9. Clean the end of the male coupler for the high speed arrangement. Connect an oil pump to the male coupler. Fill the crankcase with new oil.

Reference: Refer to Operation and Maintenance Manual, "Lubricant Viscosities and Refill Capacities" for the type of lubricant and for the refill capacity.

10. Clean the end of the male coupler and the cap that covers the male coupler. Install the cap.
11. Start the engine and allow the oil to warm. Check the machine for oil leaks.
12. Close the engine hood.
13. Check the engine oil level.

Reference: Refer to Operation and Maintenance Manual, "Engine Oil Level - Check" for the correct procedure.

i01115243

Engine Oil Level - Check

SMCS Code: 1000-535-FLV

NOTICE

Do not under fill or overfill engine crankcase with oil. Either condition can cause engine damage.

1. Park the machine on level ground and stop the engine.



Illustration 226

g00319443

2. Open the access door on the right side of the machine.

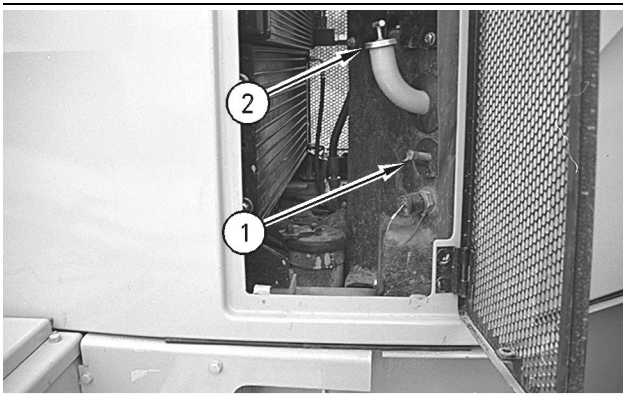


Illustration 227

g00283452

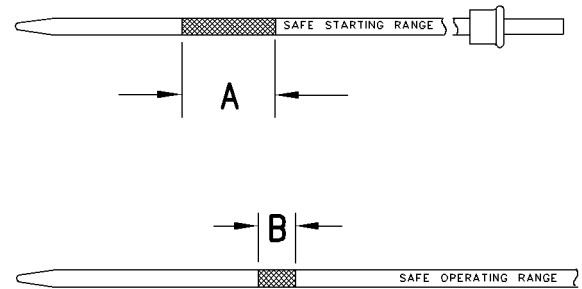


Illustration 228

g00283183

3. Maintain the engine oil within "Safe Starting Range" (A) on the dipstick.

Note: Only use "Safe Operating Range" (B) between the daily checks to ensure that the oil level is adequate for safe operation while the engine is running.

4. Remove the filler cap (2). If necessary, add oil.

Note: To avoid excessive oil consumption, do not add oil while the engine is running. Also, wait for twenty minutes after engine shutdown before you add any engine oil.

5. Clean the filler cap and install the filler cap.

6. Close the access door.

i01119507

Engine Oil and Filter - Change

SMCS Code: 1318-510



Illustration 229

g00282895

1. Open the engine hood.

2. The drain plug is located on the right side of the engine oil pan toward the rear of the machine. Open the oil drain valve and allow the oil to drain into a suitable container. Close the drain valve.

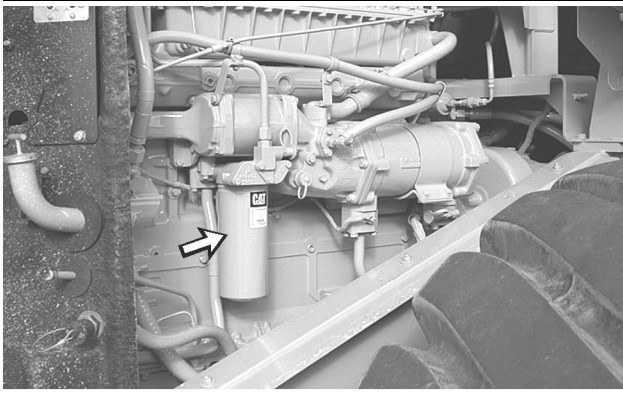


Illustration 230

g00283449

3. Use a strap type wrench to remove the engine oil filter from the right side of the engine. Inspect the oil filter.

Reference: Refer to Operation and Maintenance Manual, "Oil Filter - Inspect".

4. Clean the filter mounting base. Make sure that all of the used gasket has been completely removed.

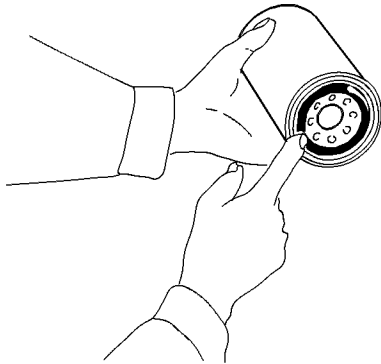


Illustration 231

g00101318

5. Apply a thin coat of clean engine oil to the sealing surface of the new filter element. Install the new engine oil filter by hand. After the filter gasket contacts the filter mounting base, tighten the filter by an additional 3/4 turn.

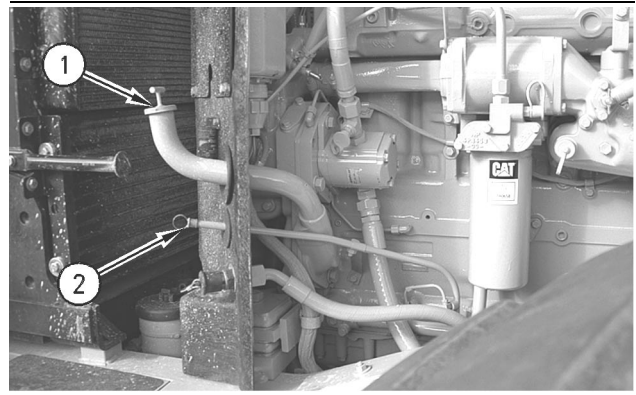


Illustration 232

g00283450

6. Remove oil filler plug (1) on the right side of the engine. Fill the crankcase with new oil.

Reference: Refer to Operation and Maintenance Manual, "Lubricant Viscosities and Refill Capacities" for the correct type of oil and for the correct amount of oil.

7. Clean the oil filler plug and install the oil filler plug.
 8. Start the engine and allow the oil to warm. Check for any oil leaks.
 9. Check the oil level on dipstick (2).
- Reference:** Refer to Operation and Maintenance Manual, "Engine Oil Level - Check" for the correct procedure.
10. Close the engine hood and stop the engine.

i01181536

Engine Valve Lash - Check

SMCS Code: 1105-535

For the correct procedure, refer to the appropriate Service Manual module for your machine's engine or consult your Caterpillar dealer.

Note: A qualified mechanic should adjust the engine valve lash because special tools and training are required.

i01715447

i01252006

Engine Valve Rotators - Inspect

SMCS Code: 1109-040

S/N: 3ZS1-Up

S/N: 7LS1-Up

S/N: 9RS1-Up

S/N: 1EW1-Up

S/N: 3PW1-Up

S/N: 3SW1-Up

S/N: 4WW1-Up

S/N: 6AW1-Up

S/N: 8XW1-Up

S/N: 9GW1-Up

Caterpillar recommends replacing valve rotators that are operating improperly. An improperly operating valve rotator will shorten valve life because of accelerated wear on the valves. Also, metal particles from a damaged valve rotator could fall into the cylinder and damage to the piston head and to the cylinder head may result.

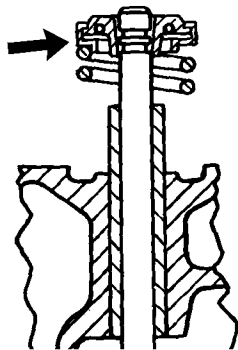


Illustration 233

g00882731

Start the engine and run the engine at low idle. Watch the top surface of each valve rotator. Whenever an inlet valve closes or an exhaust valve closes, each valve rotator should turn.

If a valve rotator fails to turn, consult your Caterpillar dealer for service.

Ether Starting Aid Cylinder - Replace (If Equipped)

SMCS Code: 1456-510-CD

WARNING

Ether is poisonous and flammable.

Breathing ether vapors or repeated contact of ether with skin can cause personal injury.

Use ether only in well ventilated areas.

Do not smoke while changing ether cylinders.

Use ether with care to avoid fires.

Do not store replacement ether cylinders in living areas or in the operator's compartment.

Do not store ether cylinders in direct sunlight or at temperatures above 49 °C (120 °F).

Discard cylinders in a safe place. Do not puncture or burn cylinders.

Keep ether cylinders out of the reach of unauthorized personnel.

To avoid possible injury, be sure the brakes are applied and all controls are in Hold or Neutral when starting the engine.



Illustration 234

g00286924

Open the engine hood. The ether starting aid cylinder is located on the left side of the engine compartment near the cab.

i00615724

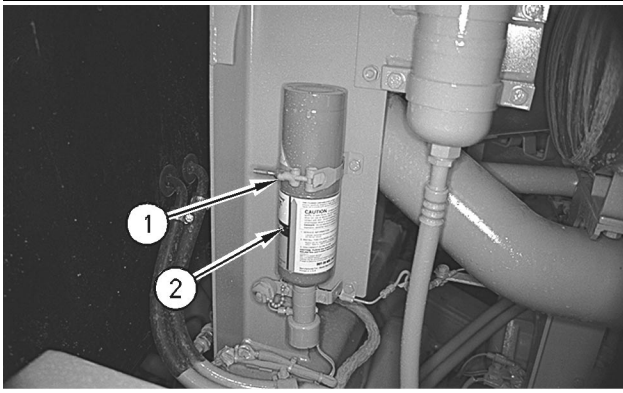


Illustration 235

g00286926

1. Loosen cylinder retaining clamp (1). Unscrew ether starting aid cylinder (2) and remove the empty ether starting aid cylinder.
2. Remove all of the used gasket. Install the new gasket that is supplied with the new ether starting aid cylinder.
3. Install the new ether starting aid cylinder hand tight. Tighten the cylinder retaining clamp securely.
4. Close the engine hood.

i00643879

Fuel Injection Timing - Check

SMCS Code: 1290-531-FT

Refer to the Service Manual for the complete adjustment procedure for the Fuel injector timing.

Note: The correct fuel timing specification is found on the Engine Information Plate. Fuel timing specifications may vary for different engine applications and/or for different power ratings.

A qualified mechanic should adjust the fuel injector timing because special tools and training are required.

Fuel System - Prime

SMCS Code: 1250-548



Illustration 236

g00286766

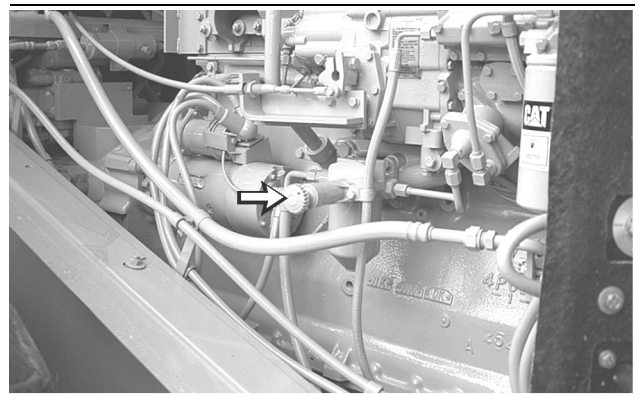


Illustration 237

g00285168

1. Open the engine hood in order to access the fuel priming pump. The fuel priming pump is located on the left side of the engine above the primary fuel filter.
2. Turn the priming pump plunger counterclockwise and pull out the priming pump plunger. Operate the priming pump plunger until resistance is felt. This indicates that the fuel filter is full of fuel.
3. Push the priming pump plunger inward and turn clockwise in order to lock the priming pump plunger.
4. Start the engine. Look for leaks around the fuel filter assembly. If the engine does not start, or if the engine misfires, more priming is necessary.

i00599785

Fuel System Primary Filter - Clean/Replace

SMCS Code: 1260-070; 1260-510



Illustration 238

g00286766

1. Open the engine hood in order to access the left side of the engine compartment.

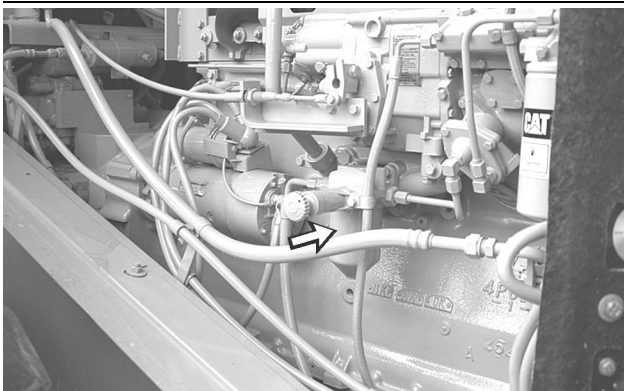


Illustration 239

g00283222

Primary Fuel Filter

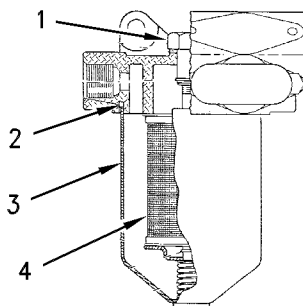


Illustration 240

g00283342

Retaining bolt (1). Gasket (2). Case (3). Filter element (4).

2. Loosen the filter housing retaining bolt (1).

3. Remove filter housing (3) and the filter element (4).
4. Wash the filter element and the filter housing in clean, nonflammable solvent.
5. Dry the filter element with pressure air.
6. Clean the filter housing base.
7. Inspect the seal (2). Replace the seal if the seal is damaged.
8. Insert the clean element.
9. Install the element and the housing onto the filter base.

NOTICE

Do not fill fuel filters with fuel before installing them. Contaminated fuel will cause accelerated wear to fuel system parts.

10. Torque the retaining bolt (1) to 24 ± 4 N·m (18 ± 3 lb ft).

11. Close the engine hood.

i01103664

Fuel System Secondary Filter - Replace

SMCS Code: 1261-510-SE



Illustration 241

g00285598

1. Open the hood. The secondary fuel filter is located on the left side of the machine.

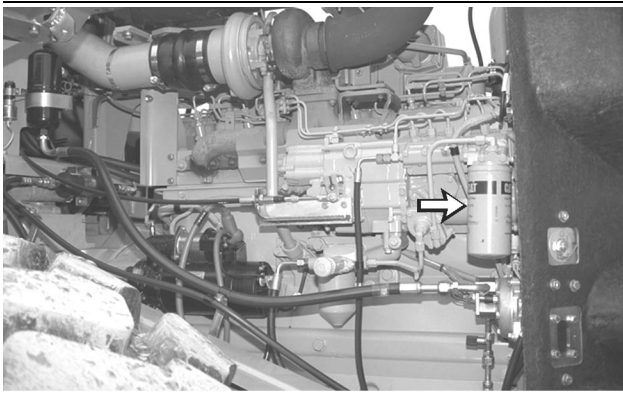


Illustration 242

g00283354

2. Remove the fuel filter. Dispose of the used filter properly.
3. Clean the filter mounting base. Make sure that all of the used gasket is removed.
4. Lubricate the gasket of a new filter with clean diesel fuel.
5. Install the new filter by hand. When the gasket contacts the filter base, tighten the filter by an additional 3/4 turn.

There are rotation index marks on the filter at 90 degree intervals. Use these marks as a guide for proper tightening.

NOTICE

Do not fill fuel filters with fuel before installing them. Contaminated fuel will cause accelerated wear to fuel system parts.

6. Prime the fuel system.

Reference: Refer to Operation and Maintenance Manual, "Fuel System - Prime" for the correct procedure.

7. Close the engine hood.

Fuel Tank Cap and Strainer - Clean

SMCS Code: 1273-070-Z2; 1273-070-STR

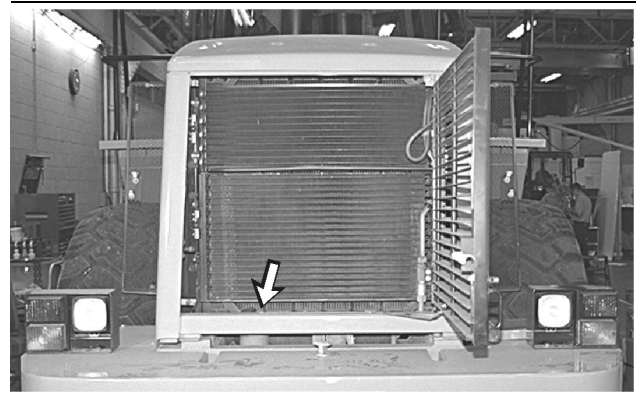


Illustration 243

g00283391

Open the rear grill in order to access the fuel tank cap.

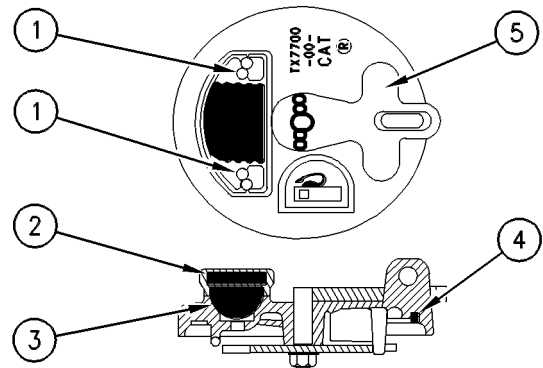


Illustration 244

g00100737

1. Lift lever (5) and turn the lever counterclockwise until the lever stops. Remove the fuel tank cap.
2. Inspect seal (4) for damage. Replace the seal, if necessary.
3. Remove screws (1), filter assembly (2), valve (3) and the gaskets.
4. Remove the strainer from the filler tube.
5. Wash the fuel tank cap and the strainer in a clean, nonflammable solvent.
6. Install a new cap filter kit. Install the other components in reverse order.
7. Install the strainer and the fuel tank cap.

i01715582

Fuel Tank Water and Sediment - Drain

SMCS Code: 1273-543-M&S



Illustration 245

g00882845

The drain valve is under the fuel tank at the rear of the machine.



Illustration 246

g00882846

1. Open the drain valve. Allow the water and the sediment to drain into a suitable container.
2. Close the drain valve.

i01232432

Fuses - Replace

SMCS Code: 1417-510

NOTICE

Replace the fuses with the same type and size only. Otherwise, electrical damage can result.

If it is necessary to replace fuses frequently, an electrical problem may exist. Contact your Caterpillar dealer



Fuses – Fuses protect the electrical system from damage that is caused by overloaded circuits. Replace the fuse if the element separates. If the element of a new fuse separates, check the circuit. Repair the circuit, if necessary.



Illustration 247

g00100597

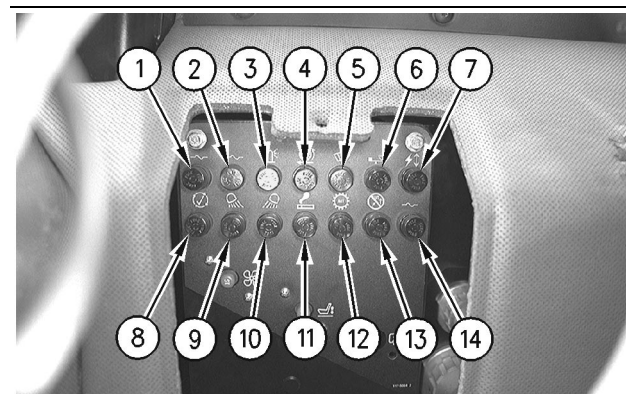


Illustration 248

g00636581

The fuse panel is located at the rear of the operator compartment.



Transmission Control (1) – 10 amp



Secondary Steering (2) (if equipped) – 10 amp



Turn Signals and Rotating Beacon (3) – 10 amp



Traction Control (4) (if equipped) – 10 amp



Window Wipers (5) – 10 amp



Payload Measurement Control (6) – 10 amp



Electrical Converter (7) – 10 amp



System Check (8) – 10 amp



Rear Floodlights (9) – 15 amp



Front Floodlights (10) – 15 amp



Lighter (11) – 10 amp



Autoshift Function (12) – 10 amp



Implements (13) – 10 amp



Dome Lamp (14) – 10 amp



Illustration 249

g00282344

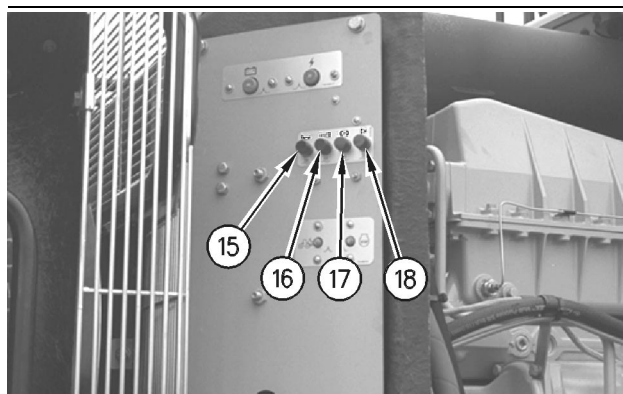


Illustration 250

g00287801

Additional fuses are located in the engine compartment on the right side of the machine.



Horn (15) – 10 amp



Engine Start Switch (16) – 10 amp



Stop Lights (17) – 10 amp



Backup Alarm (18) – 10 amp

i01715714

Hood Tilt Actuator - Lubricate

SMCS Code: 7275-086

Wipe all fittings before lubricating.

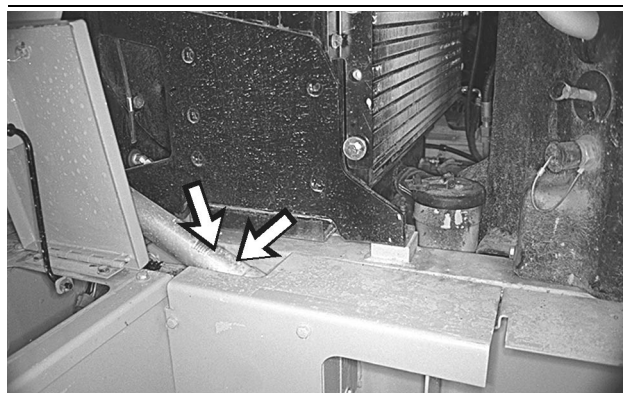


Illustration 251

g00882932

Raise the engine hood. The actuator that tilts the engine hood is located on the right side of the machine.

Lubricate the two fittings that are on the actuator.

i01102541

Hydraulic System Biodegradable Oil Filter Element - Replace (If Equipped)

SMCS Code: 5068-510

S/N: AAH1-Up

S/N: 9RS1-Up

S/N: 1EW1-Up

S/N: 3PW1-Up

S/N: 6AW1-Up

S/N: AAW1-Up



Illustration 252

g00282895

1. Open the engine hood. The oil filter is located on the right side of the machine.

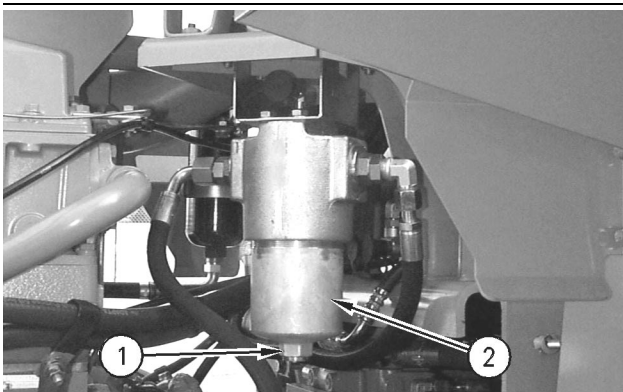


Illustration 253

g00596815

2. Remove filter housing drain plug (1). Allow the oil to drain into a suitable container.
3. Use a strap type wrench to remove filter housing (2).
4. Remove the filter element and dispose of the used filter element properly.
5. Clean the filter housing and the filter housing base in a clean, nonflammable solvent.
6. Inspect the seal on the filter housing. Replace the seal if the seal is damaged.
7. Insert a new filter element for biodegradable oil into the filter housing.
8. Install the filter housing drain plug. Install the filter housing on the filter housing base by hand.
9. Close the engine hood.
10. Start the engine and run the engine for a few minutes. Maintain the hydraulic oil level to the FULL mark in the sight gauge. Add oil, if necessary.
11. Stop the engine.

i01102958

Hydraulic System Biodegradable Oil Filter Restriction - Check

SMCS Code: 5068-535-RS; 7450-535-HR

S/N: AAH1-Up

S/N: 9RS1-Up

S/N: 1EW1-Up

S/N: 3PW1-Up

S/N: 6AW1-Up

S/N: AAW1-Up

1. Operate the machine in order to warm the hydraulic oil to operating temperature.
2. Lower the attachment to the ground. Engage the parking brake.



Illustration 254

g00282895

3. Open the engine hood. The oil filter is located on the right side of the machine.

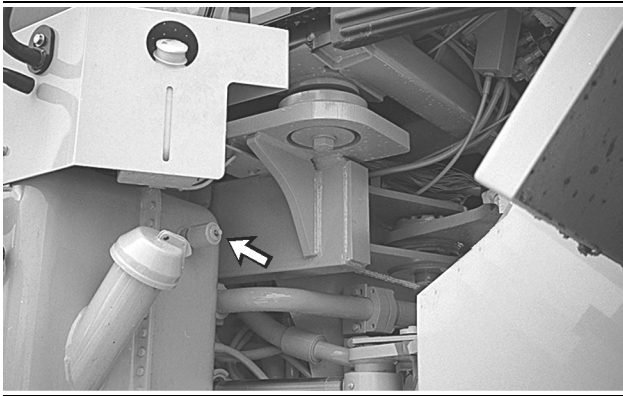


Illustration 255

g00283425

4. Press the hydraulic tank breaker relief valve in order to relieve any tank pressure.

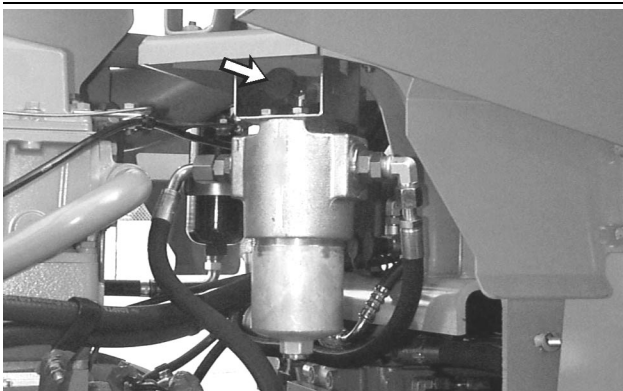


Illustration 256

g00596822

5. Install a pressure gauge on the pressure tap at the top of the filter housing.
6. Operate the engine at high idle. Read the value on the pressure gauge.

If the pressure is 3.0 ± 0.2 bars or more, the filter element is clogged. If this occurs, replace the filter element for biodegradable oil.

Reference: Refer to Operation and Maintenance Manual, "Hydraulic System Biodegradable Oil Filter Element - Replace" for the correct procedure.

i01773322

Hydraulic System Oil - Change

SMCS Code: 5056-044

S/N: 3ZS1-Up

S/N: 7LS1-Up

S/N: 9RS1-Up

S/N: 1EW1-Up

S/N: 3PW1-Up

S/N: 3SW1-Up

S/N: 4WW1-Up

S/N: 6AW1-Up

Selection of the Oil Change Interval

Your machine may be able to use a 4000 hour interval for the hydraulic oil. The hydraulic oil is in the system that is not integral to the service brakes, the clutches, the final drives, or the differentials. The standard change interval is 2000 hours. The oil should be monitored during intervals of 500 hours. The extended 4000 hour interval can be used if the following criteria are met.

Oil Filters

Caterpillar oil filters are recommended. The interval for changing the oil filter should be 500 hours.

Oil

The 4000 hour interval for changing the oil is for the following oil types.

- Caterpillar Hydraulic Oil (HYDO)
- Caterpillar Transmission and Drive Train Oil (TDTO)
- Caterpillar TDTO (TMS)
- Caterpillar Diesel Engine Oil
- Caterpillar Biodegradable Hydraulic Oils (HEES)

- Caterpillar Multipurpose Tractor Oil (MTO)
- Heavy-duty diesel engine oils with a minimum zinc content of 900 ppm (CF, CF-4, CG-4, and CH-4)

Note: Industrial hydraulic oils are not recommended in Caterpillar hydraulic systems. These oils are more likely to cause corrosion and excessive wear.

Monitoring the Condition of the Oil

The oil should be monitored during intervals of 500 hours. Caterpillar's standard SOS Fluids Analysis or an equivalent oil sampling program should be used.

The current guidelines for cleanliness of the oil should be observed. Refer to "Measured Data".

If an oil sampling program is not available, the standard 2000 oil change interval should be used.

Measured Data

The following information should be monitored through sampling of the oil:

- Significant changes in wear metals should be monitored. These metals include iron, copper, chromium, lead, aluminum, and tin.
- Significant changes in the following additives should be monitored: zinc, calcium, magnesium, and phosphorus.
- Contaminants should not be present. These contaminants include fuel and antifreeze. Water content should be .5 percent or less.
- The silicon level should not exceed 15 parts per million for new oil. The particle counts should be monitored.
- The recommended level of cleanliness for Caterpillar machines that are operated in the field is ISO 18/15 or cleaner. The cleanliness should be monitored by particle count analysis. The levels of contamination should not exceed the normal by more than two ISO codes. Action should be taken in order to determine the cause of the contamination. The system should be returned to the original levels of contamination.
- There should not be significant changes in sodium, silicon, copper, and potassium.
- The allowable level of oxidation is 40 percent (0.12 Abs units).
- The kinematic viscosity of 100 °C (212 °F) should not exceed a 2 cSt change from new.

Procedure for Changing the Hydraulic Oil

NOTICE

Care must be taken to ensure that fluids are contained during performance of inspection, maintenance, testing, adjusting and repair of the product. Be prepared to collect the fluid with suitable containers before opening any compartment or disassembling any component containing fluids.

Refer to Special Publication, NENG2500, "Caterpillar Tools and Shop Products Guide" for tools and supplies suitable to collect and contain fluids on Caterpillar products.

Dispose of all fluids according to local regulations and mandates.

1. Operate the machine in order to warm the hydraulic oil.
2. Park the machine on level ground. Lower the attachment to the ground and apply slight downward pressure. Engage the parking brake and stop the engine.

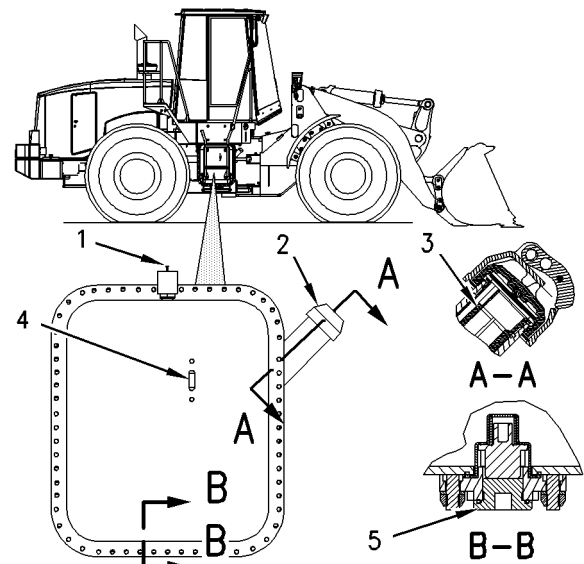


Illustration 257

g00765367

3. The hydraulic tank is located on the right side of the machine. Press the button on the breaker relief valve (1) in order to relieve any tank pressure.
4. Remove the hydraulic tank filler cap (2) and the filler strainer (3). Wash the filler cap and the strainer in a clean, nonflammable solvent. Install the strainer.

5. Inspect the gasket on the hydraulic tank filler cap for damage. Replace the gasket, if necessary.
6. Remove the drain plug (5) from the bottom of the hydraulic tank. Wash the drain plug in a clean, nonflammable solvent.
7. The hydraulic tank is equipped with an ecology drain valve. Attach a hose to a **126-7914** Oil Drain Coupling. Install the threaded end of the coupling into the drain valve in order to unseat the internal drain valve.

NOTICE

Never start the engine while the hydraulic oil tank is being drained or while the hydraulic oil tank is empty. Excessive wear and damage to the hydraulic components can occur.

8. Close the drain valve. Install the drain plug.
9. Change the hydraulic oil filter.

Reference: Refer to Operation and Maintenance Manual, "Hydraulic System Oil Filter - Replace" for the correct procedure.

10. Fill the hydraulic tank with clean oil. Make sure that the oil level is at the "FULL" mark on the sight gauge (4). Install the filler cap.

Reference: Refer to Operation and Maintenance Manual, "Lubricant Viscosities and Refill Capacities" for the correct type of oil and for the correct amount of oil.

11. Start the engine and run the engine for at least ten seconds. Then, stop the engine and add hydraulic oil to the tank until the oil level is at the "FULL" mark on the sight gauge. Install the filler cap.
12. Start the engine and run the engine at low idle. Cycle the implements so that all hydraulic systems are filled with oil.

Note: If the alert indicator for a low oil level comes on, stop the engine and immediately add oil to the hydraulic tank. The oil level should not be below the suction ports in the hydraulic tank while the engine is running.

13. Add hydraulic oil to the tank until the oil level is at the "FULL" mark on the sight gauge.
14. Stop the engine. Top off the hydraulic tank so that the oil level is at the "FULL" mark on the sight gauge. Install the filler cap.

Note: The oil must be free of air bubbles. If air bubbles are present in the hydraulic oil, air is entering the hydraulic system. Inspect the hydraulic suction line and the hose clamps.

15. If necessary, tighten any loose clamps or any loose connections. Replace any damaged hoses.

i01716511

Hydraulic System Oil - Change

SMCS Code: 5056-044

S/N: AAH1-Up

S/N: 8XW1-Up

S/N: 9GW1-Up

S/N: AAW1-Up

Selection of the Oil Change Interval

Your machine may be able to use a 4000 hour interval for the hydraulic oil. The hydraulic oil is in the system that is not integral to the service brakes, the clutches, the final drives, or the differentials. The standard change interval is 2000 hours. The oil should be monitored during intervals of 500 hours. The extended 4000 hour interval can be used if the following criteria are met.

Oil Filters

Caterpillar oil filters are recommended. The interval for changing the oil filter should be 500 hours.

Oil

The 4000 hour interval for changing the oil is for the following oil types.

- Caterpillar Hydraulic Oil HYDO
- Caterpillar Transmission and Drive Train Oil (TDTO)
- Caterpillar TDTO (TMS)
- Caterpillar Diesel Engine Oil
- Caterpillar Biodegradable Hydraulic Oils HEES
- Caterpillar Multipurpose Tractor Oil (MTO)
- Heavy duty diesel engine oil with a minimum zinc content of 900 ppm

Use heavy oils with the following classification: CF, CF-4, CG-4, and CH-4

Note: Industrial hydraulic oils are not recommended in Caterpillar hydraulic systems. These oils are more likely to cause corrosion and excessive wear.

Monitoring the Condition of the Oil

The oil should be monitored during intervals of 500 hours. Caterpillar's standard SOS Fluids Analysis or an equivalent oil sampling program should be used.

The current guidelines for cleanliness of the oil should be observed. Refer to "Measured Data".

If an oil sampling program is not available, the standard 2000 oil change interval should be used.

Measured Data

The following information should be monitored by using a program for sampling the oil.

- Significant changes in wear metals should be monitored. These metals include iron, copper, chromium, lead, aluminum, and tin.
- Significant changes in additives should be monitored. These metals zinc, calcium, magnesium, and phosphorus.
- Contaminants should not be present. These contaminants include fuel and antifreeze. Water content should be .5 percent or less.
- The silicon level should not exceed 15 parts per million for new oil. The particle counts should be monitored.
- The recommended level of cleanliness for Caterpillar machines that are operated in the field is ISO 18/15 or cleaner. The cleanliness should be monitored by particle count analysis. Contamination levels should not exceed normal levels by more than two ISO codes. Action should be taken in order to determine the cause of the contamination. The system should be returned to the original levels of contamination.
- There should not be significant changes in sodium, silicon, copper, and potassium.
- The allowable level of oxidation is 40 percent (0.12 Abs units).
- The kinematic viscosity at 100 °C (212 °F) should not exceed 2 cSt.

Procedure for Changing the Hydraulic Oil

NOTICE

Care must be taken to ensure that fluids are contained during performance of inspection, maintenance, testing, adjusting and repair of the product. Be prepared to collect the fluid with suitable containers before opening any compartment or disassembling any component containing fluids.

Refer to Special Publication, NENG2500, "Caterpillar Tools and Shop Products Guide" for tools and supplies suitable to collect and contain fluids on Caterpillar products.

Dispose of all fluids according to local regulations and mandates.

1. Operate the machine in order to warm the hydraulic oil.
2. Park the machine on level ground. Lower the bucket to the ground and apply slight downward pressure. Engage the parking brake and stop the engine.



Illustration 258

g00883102

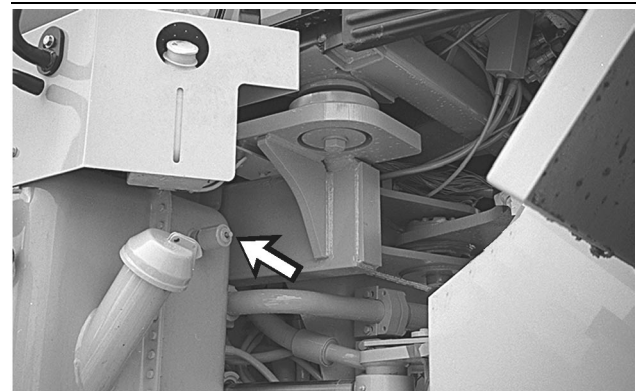


Illustration 259

g00883104

3. The hydraulic tank is located on the right side of the machine. Press the button on the breaker relief valve in order to relieve any pressure.

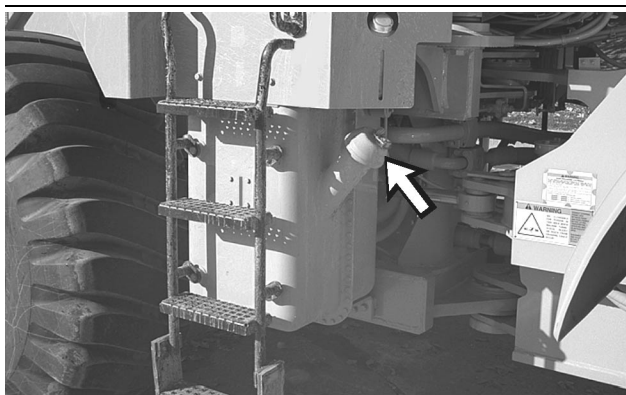


Illustration 260

g00883105

4. Remove the hydraulic tank filler cap and the filler strainer. Wash the filler cap and the strainer in a clean, nonflammable solvent. Install the strainer.
5. Remove the drain plug from the bottom of the hydraulic oil tank. Wash the drain plug in a clean, nonflammable solvent.
6. Open the drain valve. Allow the oil to drain into a suitable container.

Note: If the hydraulic tank is equipped with an ecology drain valve, attach a hose to a 126-7914 Oil Drain Coupling. Install the threaded end of the coupling into the drain valve in order to unseat the internal drain valve.

NOTICE

Never start the engine while the hydraulic oil tank is being drained or while the hydraulic oil tank is empty. Excessive wear and damage to the hydraulic components can occur.

7. Close the drain valve. Install the drain plug.
8. Change the hydraulic system filter.

Reference: Refer to Operation and Maintenance Manual, "Hydraulic System Oil Filter - Replace" for the correct procedure.

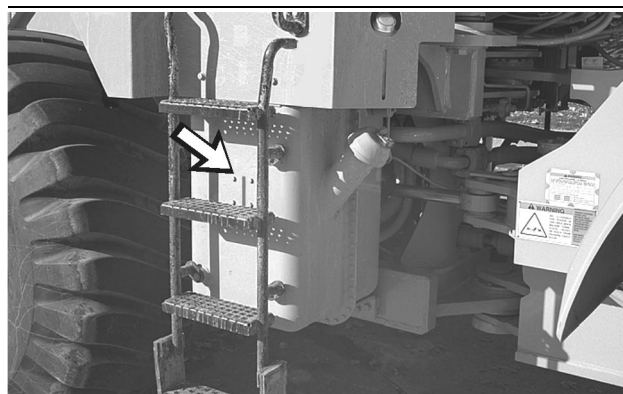


Illustration 261

g00883106

9. Fill the hydraulic oil tank with clean oil. Make sure that the oil level is at the "FULL" mark on the sight gauge.

Reference: Refer to Operation and Maintenance Manual, "Lubricant Viscosities and Refill Capacities" for the correct type of oil and for the correct amount of oil.

10. Start the engine and run the engine for at least ten seconds. Then, stop the engine and add hydraulic oil to the tank until the oil level is at the "FULL" mark on the sight gauge.

11. Start the engine and run the engine at low idle. Cycle the implements so that all hydraulic systems are filled with oil.

Note: If the alert indicator for a low oil level comes on, stop the engine and immediately add oil to the hydraulic tank. The oil level should not be below the suction ports in the hydraulic tank while the engine is running.

12. Stop the engine and top off the hydraulic tank so that the oil level is at the "FULL" mark on the sight gauge.

Note: The oil must be free of air bubbles. If air bubbles are present in the hydraulic oil, air is entering the hydraulic system. Inspect the hydraulic suction line and the hose clamps.

13. If necessary, tighten any loose clamps or any loose connections. Replace any damaged hoses.
14. Inspect the gasket on the hydraulic tank filler cap for damage. Replace the gasket, if necessary. Install the filler cap.

i01103628

Hydraulic System Oil Filter - Replace

SMCS Code: 5068-510



Illustration 262

g00283702

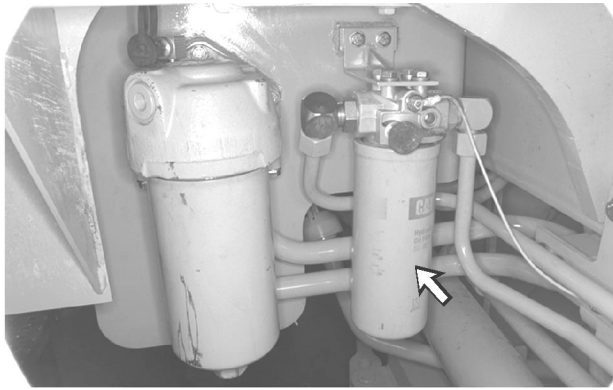


Illustration 263

g00393019

The hydraulic oil filter on the left side of the machine near the steering cylinder.

1. Stop the engine.
2. Use a strap type wrench to remove the filter element. Dispose of the used filter element properly.
3. Clean the filter mounting base. Make sure that all of the used gasket is removed from the filter mounting base.
4. Lubricate the gasket of the new filter element with clean hydraulic oil.
5. Install the new filter by hand. When the gasket contacts the filter base, tighten the filter by an additional 3/4 turn.
6. Start the engine and run the engine at low idle. Inspect the hydraulic system for leaks.

7. Check the hydraulic oil level.

Reference: Refer to Operation and Maintenance Manual, "Hydraulic System Oil Level - Check" for the correct procedure.

i01717867

Hydraulic System Oil Level - Check

SMCS Code: 5056-535-FLV

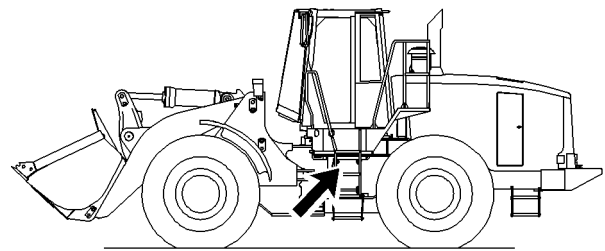


Illustration 264

g00883247

The hydraulic tank is located on the right side of the machine.

Check the oil level in the sight gauge while the engine is stopped. Maintain the oil level between the "ADD COLD" mark and the "FULL COLD" mark.

If necessary, remove the oil filler cap and add hydraulic oil.

i01717967

Hydraulic Tank Breaker Relief Valve - Clean

SMCS Code: 5118-070

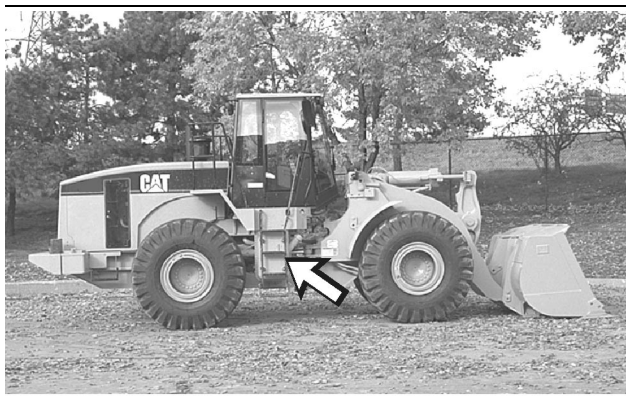


Illustration 265

g00883269

The hydraulic tank is located on the right side of the machine.

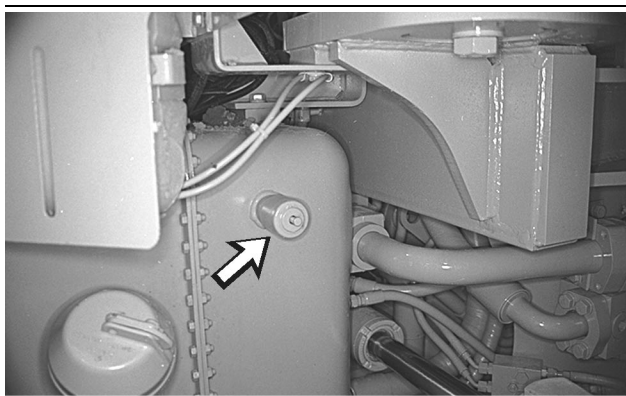


Illustration 266

g00883270

The breaker relief valve is located on the front side of the hydraulic tank near the top.

1. Remove the breaker relief valve by turning the breaker relief valve counterclockwise.
2. Clean the breaker relief valve in a nonflammable solvent. Dry the breaker relief valve thoroughly by shaking or using compressed air.
3. Install the breaker relief valve by turning the breaker relief valve clockwise.

i01715564

In-Line Refrigerant Dryer - Replace

SMCS Code: 7322-510

Reference: Before any service work is performed on the air conditioning system, refer to the Service Manual, SENR5664, "Machine Preparation for Troubleshooting" section in Testing and Adjusting.

The refrigerant dryer is located behind the cab.

1. Open the engine hood in order to access the dryer.
2. Stop the engine for five minutes in order to equalize the pressure in the air conditioning system.

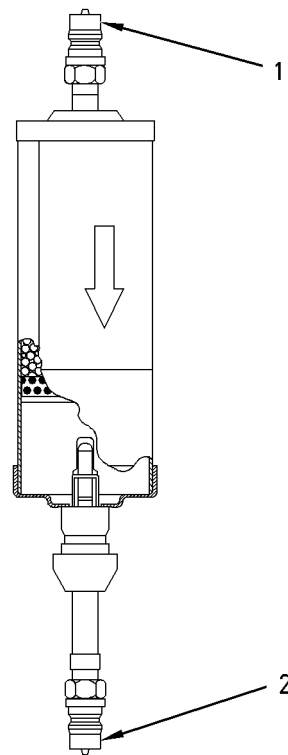


Illustration 267

g00654556

Typical In-Line Dryer with Quick Disconnects

(1) Inlet hose. (2) Outlet hose.

3. Disconnect the inlet hose (1) from the old in-line dryer.
4. Connect the inlet hose that was disconnected in Step 3 to the inlet on the new in-line dryer.
5. Start the engine and operate the air conditioning system.

6. With the air conditioning system in operation, disconnect the outlet hose (2) from the old in-line dryer.
7. Stop the engine for five minutes in order to equalize the pressure in the air conditioning system.
8. Connect the outlet hose (2) that was disconnected in Step 6 to the outlet on the new in-line dryer.

Note: Do not add oil to the in-line dryer.

9. Close the engine hood.

Note: If the moisture indicator is blue, the refrigerant dryer is operating properly. When the moisture indicator is red, the refrigerant dryer must be replaced. The dryer should be replaced yearly even if the moisture indicator is not red.

Note: If the in-line dryer assembly does not have quick disconnects, 30 mL (1 oz) of refrigerant oil will need to be added to the air conditioner system.

Reference: For the proper procedure, refer to the Service Manual, SENR5664, "Refrigerant Recovery" section in Testing and Adjusting.

i01103624

Lift Arm and Cylinder Linkage - Lubricate

SMCS Code: 5102-086; 6107-086

Wipe off the fittings before any lubricant is applied.

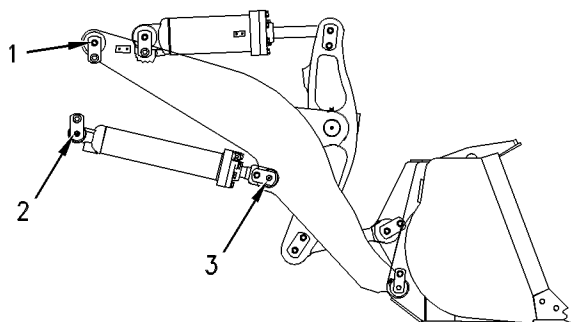


Illustration 268

g00283747

To lubricate pins (2) and (3), apply grease through the fittings on both sides of the linkage.

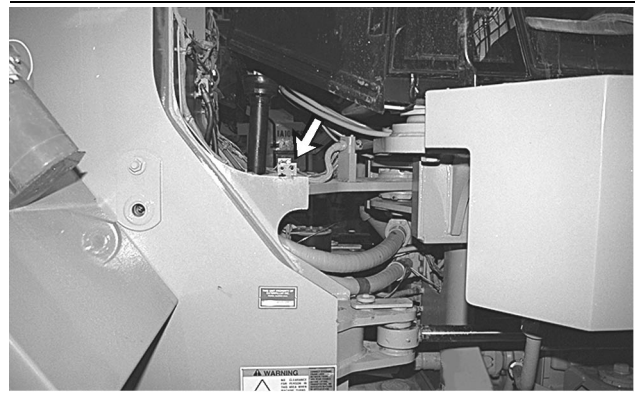


Illustration 269

g00283749

Left Side

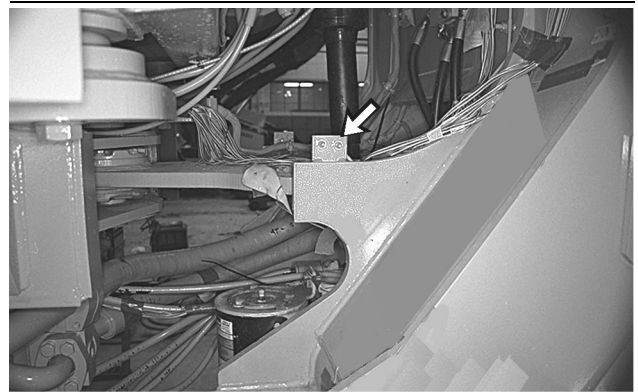


Illustration 270

g00285535

Right Side

To lubricate pin (1), apply lubricant through one remote fitting on each side of the machine.

There is a total of six fittings.

i01718807

Logging Fork Clamp - Lubricate

SMCS Code: 6113-086-BD; 6410-086-BD

Wipe off all fittings before any lubricant is applied.

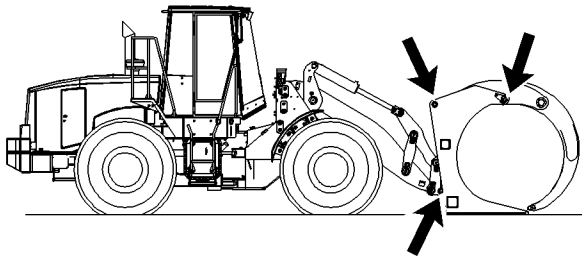


Illustration 271

g00883679

Apply lubricant through three fittings on each side of the logging fork.

There is a total of six fittings.

i01719384

Oil Filter - Inspect

SMCS Code: 1308-507; 3004-507; 3067-507; 5068-507

Inspect a Used Filter for Debris

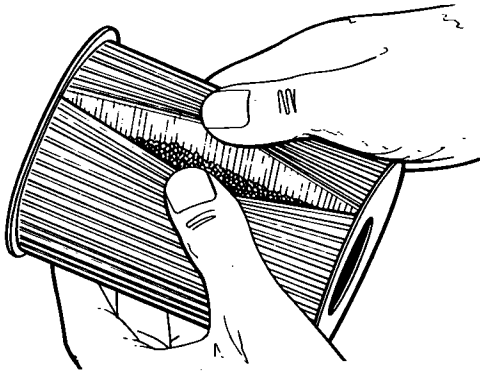


Illustration 272

g00100013

The element is shown with debris.

Use a **4C-5084** Filter Cutter or a **175-7546** Oil Filter Cutter to cut the filter element open. Spread apart the pleats and inspect the element for metal and for other debris. An excessive amount of debris in the filter element can indicate a possible failure.

If metals are found in the filter element, a magnet can be used to differentiate between ferrous metals and nonferrous metals.

Ferrous metals can indicate wear on steel parts and on cast iron parts.

Nonferrous metals can indicate wear on the aluminum parts of the engine such as main bearings, rod bearings, or turbocharger bearings.

Small amounts of debris may be found in the filter element. This could be caused by friction and by normal wear. Consult your Caterpillar dealer in order to arrange for further analysis if an excessive amount of debris is found.

Using an oil filter element that is not recommended by Caterpillar can result in severe engine damage to engine bearings, to the crankshaft, and to other parts. This can result in larger particles in unfiltered oil. The particles could enter the lubricating system and the particles could cause damage.

i01719323

Radiator Core - Clean

SMCS Code: 1353-070-KO

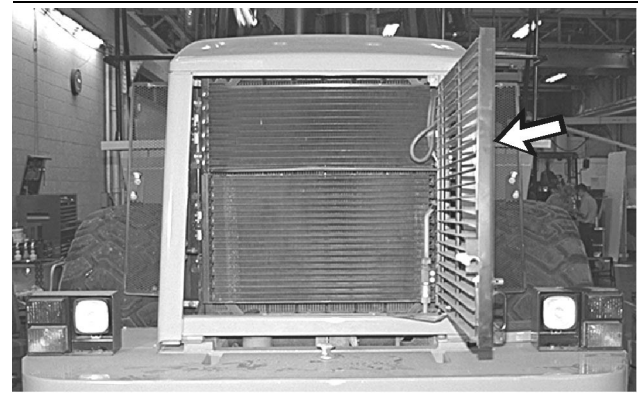


Illustration 273

g00883954

Open the rear grill in order to access the radiator.

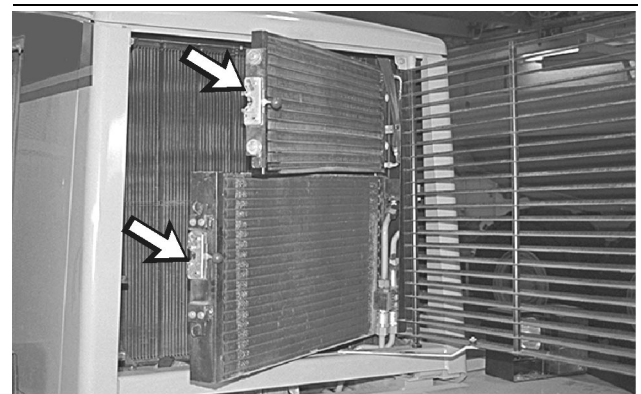


Illustration 274

g00883956

The condenser and the oil cooler may be rotated away from the radiator in order to improve cleaning. Use the control handles in order to swing the condenser and the oil cooler away from the radiator.

i01457015

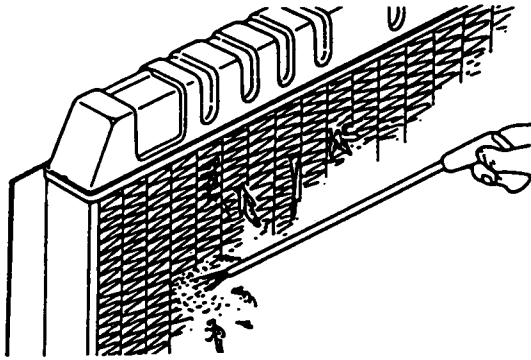


Illustration 275

g00100062

You can use compressed air, high pressure water, or steam in order to remove dust and other debris from the radiator core. However, the use of compressed air is preferred.

Reference: Refer to Special Publication, SEBD0518, "Know Your Cooling System" for the complete procedure for cleaning the radiator core.

i01767205

Ride Control Accumulator - Check

SMCS Code: 5077-535-R6

Note: When the ride control accumulator is properly charged, the fore and aft motion of the machine is reduced by the ride control accumulator.

Special tools and equipment are required in order to test the accumulator.

Reference: For more information, refer to Testing and Adjusting, RENR4397, "966G Series **II** Wheel Loader and 972G Series **II** Wheel Loader Hydraulic System", "Ride Control Accumulator - Test and Charge" or consult your Caterpillar dealer.

Roading Fender Hinges - Lubricate

SMCS Code: 7252-086-HNG

S/N: AAH1-Up

S/N: 9RS1-Up

S/N: 1EW1-Up

S/N: 3PW1-Up

S/N: 6AW1-Up

S/N: AAW1-Up

Wipe off the fitting before any lubricant is applied.

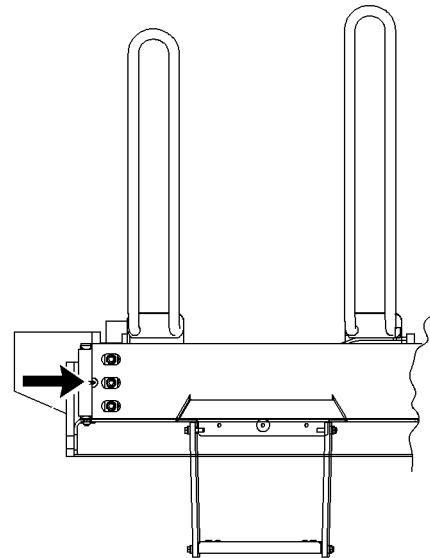


Illustration 276

g00761700

Swing open the roading fender. Apply lubricant through one fitting on the hinge. There is one hinge on each side of the machine.

i01457460

Rollover Protective Structure (ROPS) - Inspect

SMCS Code: 7323-040; 7325-040

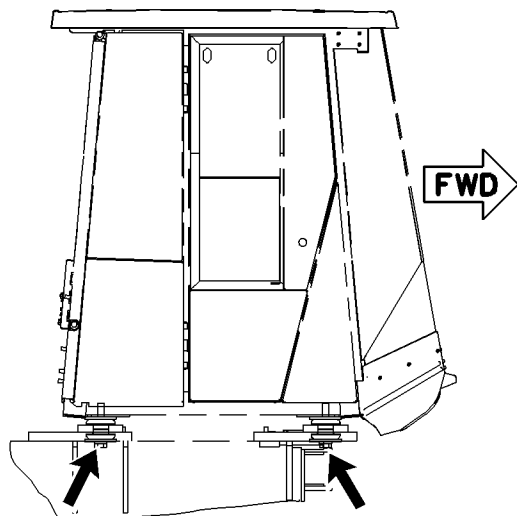


Illustration 277

g00762107

Inspect the ROPS for bolts that are loose or damaged. Use original equipment parts only to replace bolts that are damaged or missing. Tighten the four cab mounting bolts to a torque of 850 ± 100 N·m (629 ± 74 lb ft).

Note: Apply oil to all bolt threads before installation. Failure to apply oil can result in improper bolt torque.

Do not repair the ROPS by welding reinforcement plates to the ROPS. Consult your Caterpillar dealer for repair of cracks in any welds, in any castings, or in any metal section of the ROPS.

i01625445

Seat Belt - Replace

SMCS Code: 7327-510

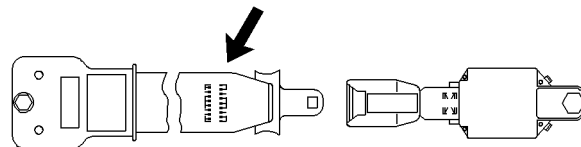


Illustration 278

g00841400

Regardless of the appearance of the seat belt, the seat belt should be replaced at every three year interval. A date label is attached to each seat belt. Use this label in order to determine the age of the seat belt.

Consult your Caterpillar dealer for replacement of the seat belt.

i01102364

Steering Cylinder Bearings - Lubricate

SMCS Code: 4303-086-BD

Wipe off the fittings before any lubricant is applied.

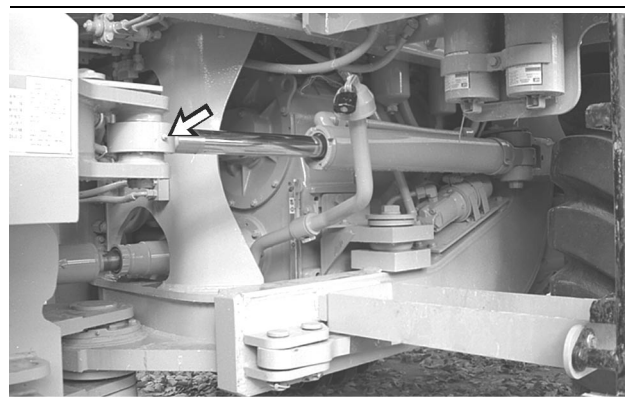


Illustration 279

g00284519

Apply lubricant through one fitting on the rod end of each steering cylinder.

i01605403



Illustration 280

g00282528

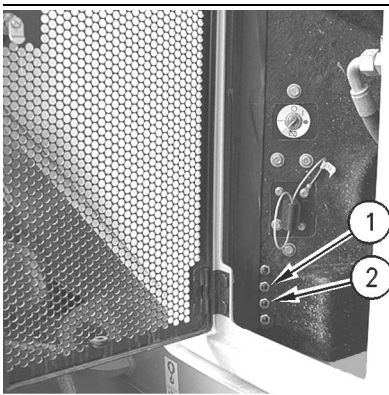


Illustration 281

g00284520

Apply lubricant through two remote fittings that are located inside the left engine access door. Fitting (1) is for the head end of the left steering cylinder. Fitting (2) is for the head end of the right steering cylinder.

Steering Pilot Oil Screen (Command Control Steering) - Clean/Replace

SMCS Code: 4304-070-Z3; 4304-510-Z3

S/N: AAH1-Up

S/N: 3ZS1-Up

S/N: 7LS1-Up

S/N: 9RS1-Up

S/N: 1EW1-Up

S/N: AAW1-Up

WARNING

Personal injury can result from working with cleaning solvent.

Because of the volatile nature of many cleaning solvents, extreme caution must be exercised when using them. If unsure about a particular cleaning fluid, refer to the manufacturer's instructions and directions.

Always wear protective clothing and eye protection when working with cleaning solvents.

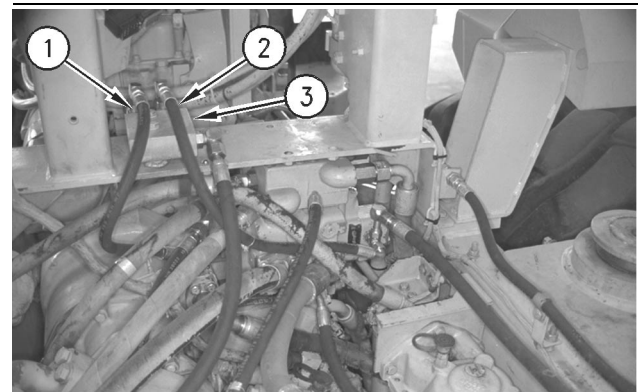


Illustration 282

g00490273

The screen group (3) is located behind the cab.

- 1.** Disconnect the hoses (1) and (2) that are connected to the screen group (3).
- 2.** Remove the two connectors that are attached to the block.
- 3.** Use an allen wrench in order to remove the two screens from the screen group (3).

4. Wash the screens in a clean, nonflammable solvent.
5. Dry each screen with pressure air. Inspect each screen for damage. Replace the screen if the screen is damaged.
6. Install the screens. Install the connectors and connect the hoses.

i01619649

Steering Shaft (Command Control Steering) - Lubricate

SMCS Code: 4343-086-JF

S/N: AAH1-Up

S/N: 3ZS1-Up

S/N: 7LS1-Up

S/N: 9RS1-Up

S/N: 1EW1-Up

S/N: AAW1-Up

Wipe off all fittings before any lubricant is applied.

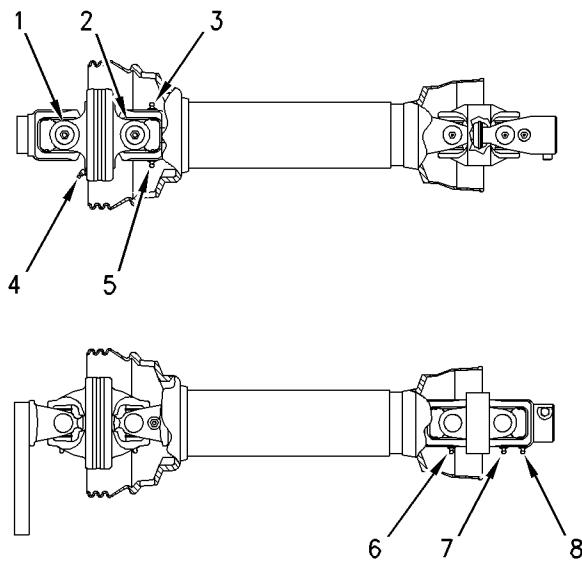


Illustration 283

g00812993

1. Remove the steering shaft from the machine.

Reference: Refer to Disassembly and Assembly, "Steering Shaft - Remove and Install" for the machine that is being serviced for the correct procedure.

2. Apply 5P-0960 Molybdenum Grease through fittings (3), (4), (5) and (8).

3. Apply 1P-0808 Multipurpose Grease through fittings (1), (2), (6) and (7).

4. Install the steering shaft.

i01103553

Tilt Cylinder Bearings and Bucket Linkage Bearings - Lubricate

SMCS Code: 5104-086; 6107-086

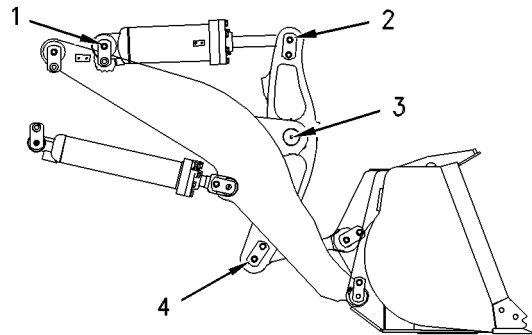


Illustration 284

g00284478

Wipe off all fittings before any lubricant is applied.

To lubricate bearings (2), (3) and (4), apply grease through the fittings on the linkage.

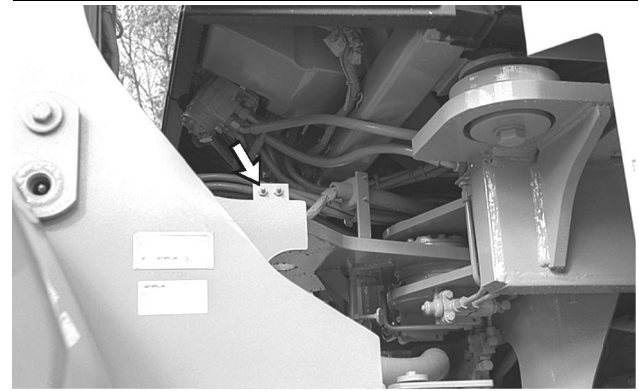


Illustration 285

g00285539

To lubricate bearing (1), apply grease through the remote fitting on the left side of the machine.

There is a total of four fittings.

i01772890

Tire Inflation - Check

SMCS Code: 4203-535-AI

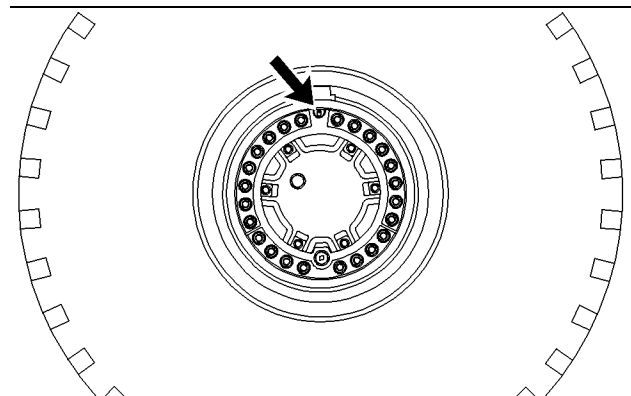


Illustration 286

g00766043

1. Measure the tire pressure on each tire.
2. Inflate tires, if necessary.

Reference: For additional information, refer to Operation and Maintenance Manual, "Tire Inflation Information".

i01720655

Transmission Oil - Change

SMCS Code: 3030-044

NOTICE

Care must be taken to ensure that fluids are contained during performance of inspection, maintenance, testing, adjusting and repair of the product. Be prepared to collect the fluid with suitable containers before opening any compartment or disassembling any component containing fluids.

Refer to Special Publication, NENG2500, "Caterpillar Tools and Shop Products Guide" for tools and supplies suitable to collect and contain fluids on Caterpillar products.

Dispose of all fluids according to local regulations and mandates.

1. Operate the engine in order to warm the transmission oil. Park the machine on level ground. Lower the bucket and apply slight downward pressure.
2. Engage the parking brake. Stop the engine.

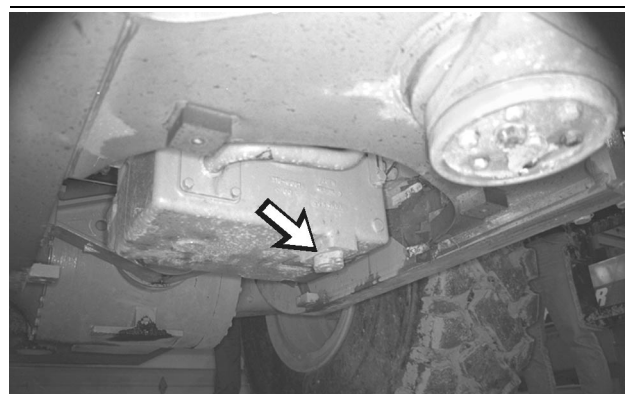


Illustration 287

g00884722

3. Remove the drain plug on the bottom of the transfer case.
4. Change the transmission oil filter.

Reference: Refer to Operation and Maintenance Manual, "Transmission Oil Filter - Replace" for the correct procedure.

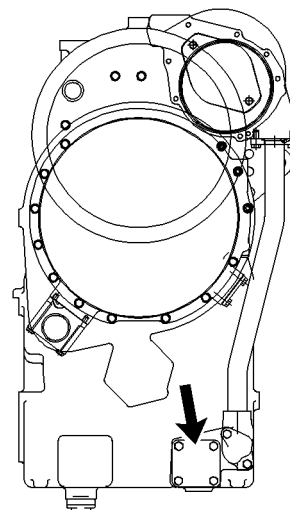


Illustration 288

g00884724

5. The magnetic strainer is on the right rear side of the transfer case. Remove the four bolts, the cover and the seal that holds the magnets and the screen in place.
6. Remove the screen and the magnets from the transfer case housing.
7. Wash the screen in a clean, nonflammable solvent. Use a bristle brush or pressure air to clean the screen. Clean the magnets. Replace any damaged magnets.

8. Clean the cover. Inspect the cover seal. Replace the cover seal if the seal is damaged.
9. Insert the magnets and the screen into the transfer case housing. Install the seal, the cover and the four bolts.
10. Clean the transmission oil drain plug and install the transmission oil drain plug.

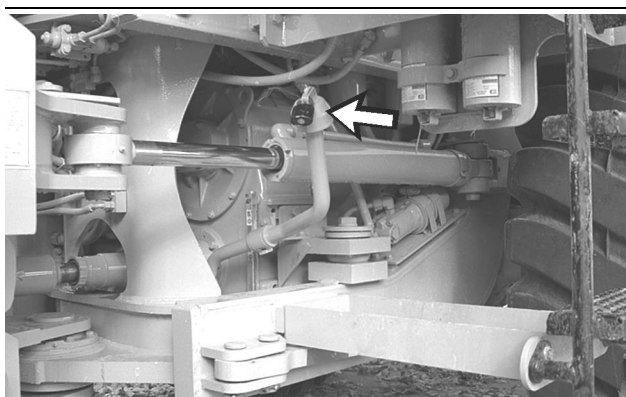


Illustration 289

g00884726

11. Remove the oil filler cap on the left side of the machine and fill the transmission with oil.

Reference: Refer to Operation and Maintenance Manual, "Lubricant Viscosities and Refill Capacities" for the type of lubricant and for the refill capacity.

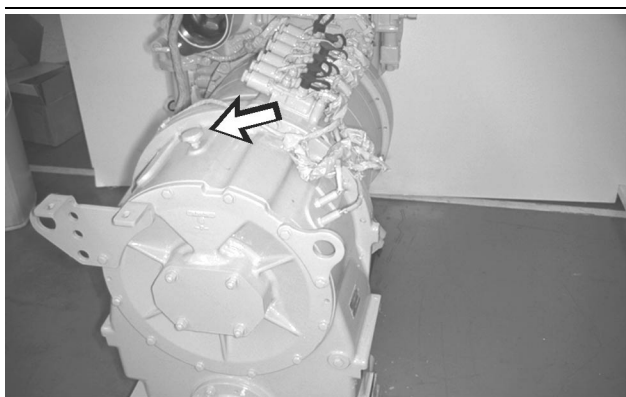


Illustration 290

g00884727

12. Remove the breather from the top of the transfer case. Wash the breather in a clean, nonflammable solvent. Install the breather.
13. Start and run the engine at low idle. Inspect the machine for leaks. Slowly operate the transmission controls in order to circulate the transmission oil.
14. Check the transmission oil level.

Reference: Refer to Operation and Maintenance Manual, "Transmission Oil Level - Check" for the correct procedure.

i01551419

Transmission Oil Filter - Replace

SMCS Code: 3067-510

NOTICE

Care must be taken to ensure that fluids are contained during performance of inspection, maintenance, testing, adjusting and repair of the product. Be prepared to collect the fluid with suitable containers before opening any compartment or disassembling any component containing fluids.

Refer to Special Publication, NENG2500, "Caterpillar Tools and Shop Products Guide" for tools and supplies suitable to collect and contain fluids on Caterpillar products.

Dispose of all fluids according to local regulations and mandates.

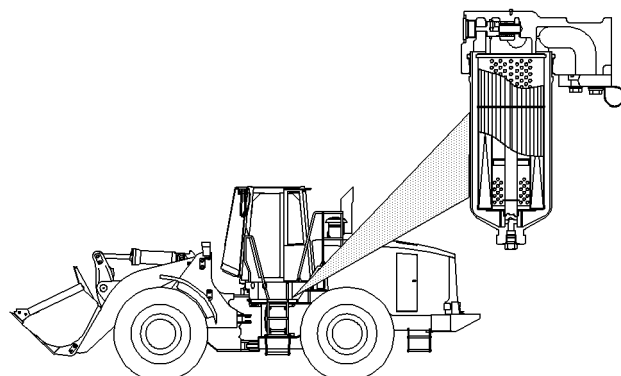


Illustration 291

g00807056

The transmission oil filter is located on the left side of the machine near the steering cylinder.

1. Operate the machine in order to warm the oil. Park the machine on level ground. Lower the bucket to the ground and apply slight downward pressure.
2. Engage the parking brake and stop the engine.
3. Remove the access panel.
4. Remove the filter housing drain plug and allow the oil in the filter to drain into a suitable container.

5. Use a strap type wrench to remove the filter housing.
6. Remove the used filter element. Dispose of the used filter element properly.
7. Clean the filter housing and the filter housing base with a clean, nonflammable solvent.
8. Inspect the filter housing seal. Replace the seal if the seal is damaged.
9. Install the new filter element into the transmission filter housing. Clean the filter housing drain plug and install the drain plug.
10. Start the engine. Slowly operate the transmission controls in order to circulate the transmission oil. Check the machine for oil leaks.
11. Check the transmission oil level.

Reference: Refer to Operation and Maintenance Manual, "Transmission Oil Level - Check" for the correct procedure.

i01720770

Transmission Oil Level - Check

SMCS Code: 3030-535-FLV



Illustration 292

g00884784

The sight gauge for the transmission oil level is located on the front of the transfer case on the left side of the machine.

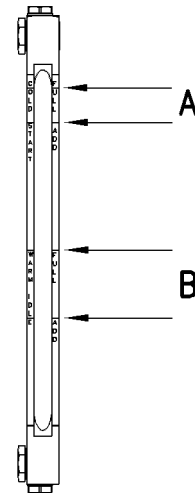


Illustration 293

g00284626

The red indicator should be within "WARM IDLE" range (B) when the oil is warm and the machine is running at low idle. The red indicator should be within "COLD START" range (A) when the oil is cold and the machine is not running. Add oil through the filler tube, if necessary.

i01552051

Window Washer Reservoir - Fill

SMCS Code: 7306-544

NOTICE

When operating in freezing temperatures, use Caterpillar nonfreezing window washer solvent or equivalent. System damage can result from freezing.

i00037755

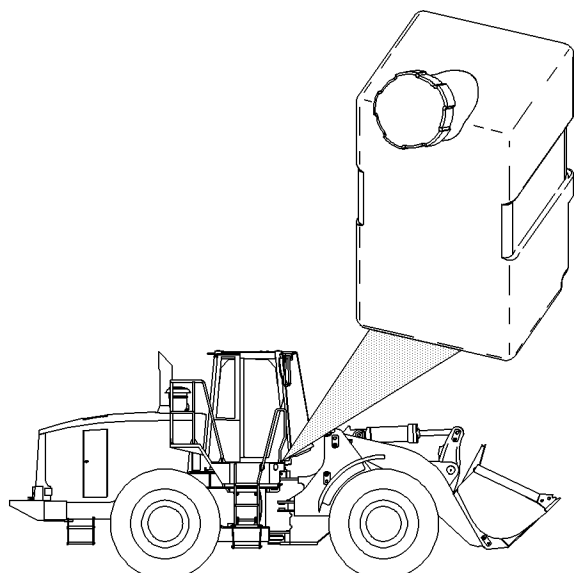


Illustration 294

g00807046



Window Washer Reservoir – The window washer reservoir is located above the hydraulic tank on the right side of the machine. Fill the window washer reservoir through the filler opening.

i01552025

Window Wiper - Inspect/Replace

SMCS Code: 7305-040; 7305-510

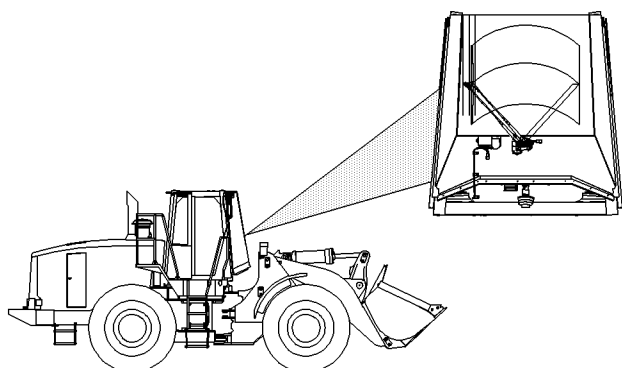


Illustration 295

g00807031

Inspect the condition of the wiper blades. Replace the wiper blades if the wiper blades are worn or damaged or if the streaking occurs.

Windows - Clean

SMCS Code: 7310-070

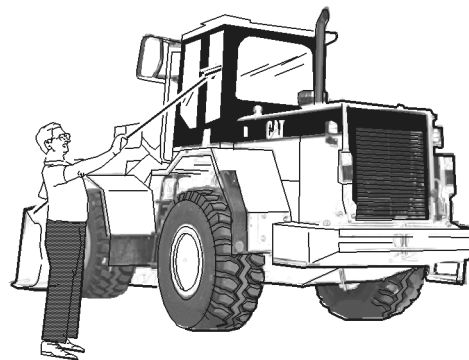


Illustration 296

g00038949

Use commercially available window cleaning solutions in order to clean the windows. Clean the outside windows from the ground unless handholds are available.